EDISON ELECTRIC INSTITUTE BULLETIN

AUGUST, 1937

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EDISON ELECTRIC INSTITUTE

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF MAY

	1937	1936	%
Kilowatthours Generated* (net)			
By Fuel	5,355,385,000	4,901,914,000	+ 9.3
By Water Power	4,103,127,000	3,551,243,000	+15.5
Total Kilowatthours Generated	9,458,512,000	8,453,157,000	+11.9
Additions to Supply			
Energy Purchased from Other Sources	295,738,000	151,206,000	+95.6
Net International Imports	107,615,000	85,782,000	+25.5
Total	403,353,000	236,988,000	+70.2
Deductions from Supply			
Energy Used in Electric Railway Departments	44,571,000	44,860,000	− 0.6
Energy Used in Electric and Other Departments	113,900,000	112,930,000	+ 0.9
Total	158,471,000	157,790,000	+ 0.4
Total Energy for Distribution	**9,703,394,000**	**8,532,355,000**	**+13.7**
Energy Lost in Transmission, Distribution, Etc.	**1,589,030,000**	**1,447,631,000**	**+ 9.8**
Kilowatthours Sold to Ultimate Consumers	**8,114,364,000**	**7,084,724,000**	**+14.5**
Sales to Ultimate Consumers (kwhrs)			
Domestic Service	1,323,205,000	1,164,724,000	+13.6
Commercial—Small Light and Power (Retail)	1,399,253,000	1,266,203,000	+10.5
Commercial—Large Light and Power (Wholesale)	4,727,100,000	3,975,184,000	+18.9
Municipal Street Lighting	146,787,000	179,907,000	−18.4
Railroads—Street and Interurban	345,998,000	353,781,000	− 2.2
Railroads—Electrified Steam	103,582,000	77,016,000	+34.5
Municipal and Miscellaneous	68,439,000	67,909,000	+ 0.8
Total Sales to Ultimate Consumers	8,114,364,000	7,084,724,000	+14.5
Total Revenue from Ultimate Consumers	$174,287,000	$164,014,600	+ 6.3

DURING TWELVE MONTHS ENDING MAY 31st

Kilowatthours Generated* (net)			
By Fuel	72,150,131,000	60,280,695,000	+19.7
By Water Power	39,065,607,000	37,075,588,000	+ 5.4
Total Kilowatthours Generated	111,215,738,000	97,356,283,000	+14.2
Purchased Energy (net)	3,788,102,000	3,220,907,000	+17.6
Energy Used in Electric Railway and Other Departments	2,124,041,000	2,185,443,000	− 2.8
Total Energy for Distribution	**112,879,799,000**	**98,391,747,000**	**+14.7**
Energy Lost in Transmission, Distribution, Etc.	**17,790,206,000**	**16,565,076,000**	**+ 7.4**
Kilowatthours Sold to Ultimate Consumers	**95,089,593,000**	**81,826,671,000**	**+16.2**
Total Revenue from Ultimate Consumers	**$2,119,839,800**	**$1,959,989,500**	**+ 8.2**
Important Factors			
Percent of Energy Generated by Waterpower	35.1%	38.1%	
Domestic Service (Residential Use)			
Average Annual Consumption per Customer (kwhr)	755	695	+ 8.6
Average Revenue per Kwhr (cents)	4.56¢	4.88¢	− 6.6
Average Monthly Bill per Domestic Customer	$2.87	$2.83	+ 1.4

BASIC INFORMATION AS OF MAY 31st

Generating Capacity (kw)—Steam	24,046,600	23,979,600
—Waterpower	9,515,600	9,011,900
—Internal Combustion	616,500	498,700
Total Generating Capacity in Kilowatts	34,178,700	33,490,200
Number of Customers		
Farms in Eastern Area (Included with Domestic)	(825,930)	(595,253)
Farms in Western Area (Included with Commercial—Large)	(292,740)	(220,627)
Domestic Service	22,007,802	21,245,808
Commercial—Small Light and Power	3,847,204	3,782,806
Commercial—Large Light and Power	554,600	493,307
Other Ultimate Consumers	71,139	62,747
Total Ultimate Consumers	26,480,745	25,584,668

* By courtesy of the Federal Power Commission, with deductions for certain plants not considered electric light and power enterprises.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 5 AUGUST, 1937 No. 8

The Electric Industry In Canada

Accomplishments and Problems of Our Next-Door Neighbors—Radical Ideas of Government in U.S.A. Have Repercussions in the Dominion

By E. H. Adams

President, Canadian Electrical Association

From the President's report to the Forty-seventh Annual Convention of C.E.A.

THE past year is a record of accomplishment, and is to some extent a barometer by which business recovery can be measured.

The output of electrical energy in Canada was the greatest in the history of the industry, reflecting 25,493,474,000 kwhr as compared with 18,093,802,000 in the pre-depression peak year 1930, or an increase of 40 per cent. It should be pointed out, however, that in the year under review sales for electric steam boilers accounted for 6,922,840,000 kwhr, but notwithstanding these sales the output was greater than in any previous year.

The investment in power plant facilities in Canada has grown in ten years from $866,825,000 to $1,455,000,000 in 1936, or an increase of approximately 68 per cent. While there was an increase in revenue during the same period from $104,033,000 to $138,320,000 in 1936, this increase represents 33 per cent; and for the reason that the revenue in 1936 reflects an income return of $9.50 per $100 of plant investment, as compared with a return of $12.00 in 1927, it may be safely assumed that the lower income return in 1936 is largely due to the lower rates for electric service which have been instituted throughout the country during that period.

The Contribution of the Industry toward Government

In every community there are individuals who advocate adventures into Government and Municipal ownership as a method of stimulating industry or lowering the cost of domestic and commercial lighting. Unfortunately the advocates of these proposals do not always state the facts, nor do they refer to the discrimination which exists between the taxation of privately owned and publicly owned utilities.

Let us see what are the facts in this connection.

The records show that during the last ten years the number of publicly owned electrical undertakings in Canada decreased from 202 to 169, while the number of privately owned electric undertakings increased to 397. We also find that the revenue of the privately owned utilities was $79,341,554 as compared with $47,836,400, being the revenue of the municipal undertakings.

But the most striking figures are that the privately owned undertakings contributed in taxes toward the cost of Dominion, Provincial and Municipal Government, in the last year, $7,524,000, or 9.48 per cent of their total gross income, as compared with a contribution of $510,556 or 1.07 per cent of the gross income of publicly owned undertakings.

If these public undertakings had been taxed on the same basis as the privately owned utilities, viz., 9.48 per cent, they would have paid approximately $4,500,000 or nearly $4,000,000 more than they now pay. The absence of public knowledge of these facts is regrettable, as the advocates of municipal ownership in their comparisons of rates conveniently overlook this unwarranted and unjust discrimination.

These taxes paid by private companies are now so large that they represent a considerable fraction of a cent per kilowatt hour. In other words, if public utility companies were relieved of taxes so as to be on a par with municipal utilities their rates could be reduced materially.

We have the admission by the Hon. Arthur Roebuck, until recently the Attorney General of Ontario, to the effect that if the Ontario Hydro-Electric Commission were subject to municipal taxation cheap power in Ontario would be a thing of the past. That public utility companies have been able to avoid increasing rates as taxes mounted is a tribute to their efficiency, and a reason why they have a place in our economic structure.

After all, despite the diversions of the theorists, the only items which matter with the public are cost and quality. Left to judge for themselves, there is no question that the public would express their satisfaction with the service they are receiving from our companies.

Yardsticks and Propaganda

We cannot but view with apprehension the spread of radical ideas of government in the United States, for they have their repercussions in Canada. It is freely stated that the so-called "yardstick" is really a big stick to hold over private companies as a threat. There is a right cost of electric service, and the use of government force will not transform a wrong cost into the right. Inevitably society pays for such wrong economics, just as false monetary policies bring their own penalties in the loss of confidence and the flight of capital.

The electrical industry has made phe-

nomenal progress due to the ability of the men at the head of it. Skilled through years of experience in building plants and distribution lines, in adopting the technical inventions of the age and in serving the public, they have an enviable record of improving service and lowering rates.

It is difficult to separate sincere though mistaken theorists from political aspirants, but we must recognize the presence of both. In the course of public affairs it was inevitable that power companies and other public utility companies should be seized upon as a convenient means of putting some theory into execution. Those reformers seldom think of taking over dairies or grocery stores, in each of which the family spends much more than it does on domestic electricity, and we are forced to the conclusion that they are not concerned with reducing the cost of living to the public as much as in putting in effect a theory.

The fact that our businesses are efficiently managed and economically operated causes these reformers to cast envious eyes upon us. As with most theorists, they are apt to keep strictly away from facts, because facts would disclose how small a proportion of the family budget goes for electric service. The average family in Canada spends only seven cents a day for electric service, whereas in taxes to the various governments the family pays out many times as much. The tax on gasoline sales in the United States is greater than the nation's total bill for domestic electric service. If political aspirants would pay as much attention to reducing taxes as they do to electric service they would save the public much more money.

It is significant that of the 1,700,000 users of electric service in Canada 1,400,000 are householders, and they use only nine per cent of the total output of electricity.

One of the current tendencies is to preach what you would not practice. The man who demands free speech would set up a system of society in which there would be none. The advocate of planned economy would be the first to demand the right to live the way he wanted to. Those who compare electric rates would be the last to set up equalized rates over the whole continent. It is the habit of the theorist to compare only the most favorable—perhaps the lowest on the continent—and ignore the others.

Apart altogether from the devious bookkeeping systems used by municipally or government owned utilities, there can never be any dead level of rats. Each community, each section of the country has its own conditions and characteristics which make the setting up of a "yardstick" futile.

Reasons for Rate Differences

The layman does not understand and is not informed that the cost of developing hydro-electric power, which constitutes 98 per cent of Canada's electric power supply, varies greatly. In certain places no storage is necessary as the volume of water available remains fairly constant throughout the year. Other places need expensive dams to store water over the dry season, thus adding to the cost of development. Diversion dams, tunnels, pipelines, and other local characteristics present other wide variations in capital cost. Distribution costs vary according to the density of population, the industrialization of a territory, necessity for placing lines underground, and so forth.

The quantity of electrical energy used by households affects the rates, and the consumption is affected in various ways. The presence of suitable domestic coal makes for cheaper gas, which together with wood fuel are competitors in some of the larger uses for electricity. The economic standards of a city also have a bearing on consumption of current, and thus on rates.

The use of current largely depends on the ability of customers to buy the appliances with which they can use it. This is all the more important when it is realized that we must pay from 15 to 30 per cent more for our electrical apparatus, such as generators, transformers and switches, than they do in the United States, and that many electrical appliances are correspondingly higher, making it more difficult for the customer to buy the devices to use current. This proves that Canadian public utility companies have done an outstanding job of electrifying the homes of this country, about which we need take second place to none.

In the United States government power projects are so intermixed with navigation, irrigation and flood control as to be unrecognizable, and there is a corresponding opportunity to slough off charges to relief and other general accounts which legitimately belong to power development.

If people were content to value electric service on the basis of what it is worth, there would, I feel, be not the slightest ground for complaint. It is because comparisons are continually being made between two entirely different items that agitation is stirred up.

No public utility company objects to fair comparisons, but with municipal or government undertakings they are seldom fair. Besides the absence of any standard bookkeeping system there is the very large item of taxes, which are heavy expenses for companies and negligible for government owned utilities.

The Relationship of the Association to the Industry

Regarding the affairs of the Association, we have had, in my opinion, a most successful year. This convention, of course, is only the culmination of a year of work by the various officers and committees of the Association. There is sometimes a tendency to deprecate the value of conventions, but if we accomplish nothing but better acquaintanceship and an opportunity to exchange ideas we have taken an important step forward in promoting our own affairs. The day is past when each of us could make progress independently of the others. All progress today is made on the foundations of yesterday. Each of us is discovering something new, something better, something more successful. None of us has a monopoly of new ideas, but we can interchange them and each of us will benefit. Furthermore, we need inspiration from time to time, which we cannot get by staying at home. Our industry has been built up by men of vision, and there is still to be obtained a picture of what we may accomplish in the future.

We are more and more becoming commercial enterprises with something to sell, and if we are to keep abreast with our competitors, of whom there are many, we must utilize the best selling methods. It will bear repeating that the most satisfied customer is the high-consumption customer, especially with inducement rates in general use. Of the electrical devices for the home, with electric cooking and refrigeration now well accepted, the next great potential load is water heating. Lighting has also taken on a new significance in recent years with the invention of the sight-meter and the setting of proper standards of light for various tasks. An entire new activity, both domestic and commercial, has been born to sell lighting, once thought to require no selling. Probably no department of a company's work will bring such beneficial returns to all concerned as lighting promotion.

Forbes Prize Paper

Public Relations—Lip Service Only?

By Clarence M. Kilian

(Author's note: This presentation is to be construed as neither an appraisal of, reflection on nor commendation of the public relations policies of the company with which the author is associated, or any other specific company. It states his personal viewpoint of fundamental truths, concurrence with which he would consider necessary if the responsibility for directing and coordinating a program for improved public relations were his for a public utility company or any other business with a large number of retail customers.)

YOU can't grow a tree by talking about it, neither will you have much luck if you try to grow branches and foliage before you have well established roots and trunk.

There has been much past talk about creating good public relations for public utilities. There have been passionate, spasmodic and sometimes poorly conceived and misdirected efforts toward good public relations. Where misconceived and misdirected, the effort has failed—with a result opposite from that hoped for. Where this was not the case, effort and interest frequently languished after the initial spurt of enthusiasm passed and the wished-for good public relations did not spring forth, full-grown, overnight. Or in cases where the miraculous did happen, whether from the effort or otherwise and the roots of a good public relations grew rapidly into a full-grown tree pleasant to behold, good public relations for such a company became accepted as commonplace, were looked upon as a permanency and expected to be as ever-present as the sky. Assiduous attention and cultivation lessened and in depression years was discontinued because it was "too expensive."

So again, public utilities find themselves asking, as their representatives asked in meeting after meeting fifteen years ago, "What must we do to make more of our customers like and believe us?"

The horticulturist, when a tree is sick, dies or is destroyed, either plants another seed or takes a twig, which he roots, and starts growing another tree.

Perhaps we who are in the public utility business should emulate the horticulturist and plant a new public relations seed, or sprout a new twig. Let us avoid duplicating some of our previous efforts at growing a tree, branches and foliage first, and for awhile confine ourselves to fundamentals—roots and trunk. If they are good, the branches and foliage will follow as a matter of course. And let us be as consistent as the horticulturist—after we have planted our seed or twig, let us cultivate it according to the soil in which it must grow and let us then give our growing "public relations tree" the constant attention the horticulturist gives his new tree.

MR. KILIAN

Mr. Kilian was awarded the 1937 B. C. Forbes Prize.

Mr. Kilian is a native of Ohio but has resided in the South since 1917, where he has been engaged in various capacities in the electric light and power business. He has been employed by the Alabama Power Company since 1935, beginning as Assistant Advertising Manager. He has recently been made Advertising Manager of the company. Previous to 1935 he had been with the Electric Bond and Share Company of New York as field Advertising and Merchandise sponsor and with the Tennessee Public Service Company of Knoxville as Assistant to the General Manager.

Since entering the public utility business Mr. Kilian has specialized in sales promotion work and advertising and has had a large and varied experience in handling problems of these departments which touch so closely the general subject of public relations.

I am assuming that the soil in which a public utility must grow its good public relations tree isn't as good as it might be; that the growth and fruition of the tree is earnestly desired; that past lip-service to and wishful thinking for good public relations, and past attempts to grow branches and foliage first, have been replaced by a desire to grow roots and trunk first. If my assumptions reflect a condition, then let the public utility conduct a searching self-examination. Let it ask itself, concerning its public relations "program," the questons listed in this paper and let it give frank, honest answers to them. Let it willingly admit the weaknesses the questions and answers may suggest. Perhaps it may then have some indication of whether its present attempts at growing a good public relations tree are likely to be as successful as it would like them to be.

Perhaps some of the questions that I suggest a public utility ask itself may seem elementary—but that is the way of fundamentals, and a review of them is sometimes salutary. Let us ask

Is good physical service the sole requirement for good public relations? ..... NO

Can good personal service help develop good public relations even though physical service may not be as good as it might be? PERHAPS

Do activities and behavior of employees OUTSIDE of business hours have any effect on public relations—favorable or adverse? YES

Considering early education, environment, experience and nature of work of the individual employee, does each have a *common understanding* of what "being nice" to the customer means? NO

Isn't an employee likely to be more attentive to creating good will for his company through his manner and attitude toward customers if he knows he is being observed, than he would be if he

were "on his own" — without guidance? .....YES

Does an appearance of secrecy about the company's affairs breed doubt among employees and is this doubt reflected to customers? .....YES

Can employees feel that they are a part of the business if most of the information about their company comes to them through newspapers rather than directly from the management?..... NO

Do employees generally like to feel that they ARE a part of the business, rather than merely employees? .....YES

Does direct commendation, by higher executives, for work well done by a minor employee create loyalty toward the management? YES

Is the average employee's effectiveness in creating good public relations influenced by his attitude toward the management?..YES

Do employees generally hesitate to express their viewpoint to superiors, particularly if they feel their viewpoint is at variance with that of the superior?.....YES

Can the viewpoint of the minor employee be of help in determining what is needed to create good public relations? .....YES

Can employees, without continual executive support and guidance, be as effective in helping create good public relations as they might otherwise be?..... NO

Do employees like to be "educated" in formal meetings?.... NO

Do they like to be *informed* informally? .....YES

Can executives, without the cooperation of other employees, create good public relations?..... NO

Can executives or other employees individually create bad public relations? .....YES

Can executives and other employees working together with mutual understanding create good public relations? .....YES

Does the "common man" constitute a big majority of public utility customers? .....YES

Aren't the appeals of the demagogue and "reformer" directed to the "common man" in language he can understand?.....YES

Are these appeals effective?....YES

Can a lesson be learned from the effectiveness of the appeal of the demagogue and reformer?.....YES

Can neat, clean, well-lighted stores and offices be very effective in creating good public relations if the attitude of the personnel in them is cold, disinterested, unintelligent, flippant or belligerent? NO

Is the customer much interested in the problems of public utilities? ..... NO

Is the customer interested in his own problems and how they are affected by the public utility?...YES

Would a central review and tabulation of complaints *after* the complaint had been handled give the management a picture of the policies, activities or employee actions that were having a tendency to create ill will?.....YES

Can credit and collection men to some extent *avoid* creating ill will and yet not be lax in their duties? .....YES

Would a standing offer, appearing in each of the company's advertisements, for a certain reward for any suggestion submitted by a customer for improvement in the company's service, and adopted by the company, reflect a spirit conducive to a friendly feeling for the company?.....YES

When a customer makes a suggestion, even one that cannot be adopted, does that not indicate that perhaps he has an interest in the company's affairs, even though his interest may be a selfish one? .....YES

Where customers made suggestions that could not be adopted, wouldn't their action present a splendid opportunity for a qualified person to contact them, explain why the suggestion could not be adopted, discuss other features of the company's operation and thus enlighten the customer to the extent that he might have a more tolerant viewpoint about the company? .....YES

Do utility companies generally take their appeals for reason and a fair attitude, to their customers in the language and manner of the "common man," and do they speak of advantages that will accrue to HIM if he concurs with their viewpoint? ..... NO

Is the language in the public announcements of public utilities frequently abstract, legalistic, statistical or technical, and is there a tendency to present it in dull, undramatic fashion?.....YES

Can good public relations be won by advertising and "publicity" alone? ..... NO

Can advertising written in language the layman can understand, even though the advertising not be a literary or artistic gem, play any part in the crystallization of good public relations? .....YES

Does abstract, statistical, "intellectual" and "profound" advertising have any great effect on the public consciousness? ..... NO

Can advertising which glorifies theories of service which are not carried out in practice make the customer conscious of ill will toward the advertiser?.....YES

Is the *average* general executive, trained in engineering, law or finance, likely to be a good judge of the manner, language and style to be used in public statements to appeal to the customers' viewpoint? ..... NO

Is he a good judge of the TRUTH of facts to be used in the advertising or publicity story? .....YES

Does engagement in politics *create* good public relations?..... NO

Can it harm them?.....YES

Do under-cover activities, even when honest, create suspicion when they become known?.....YES

Does suspicion and doubt prompt public ill will?.....YES

Does continual silence after untrue attacks breed suspicion among both public and employees that the attacks are based on facts? .....YES

Can favorable newspaper editorials *invariably* be interpreted to mean good public relations?.. NO

Do frequent publicity releases alone constitute a public relations program? ..... NO

With problems of finance, operation, law, political baiting and general management to engage his attention, is it probable that the major executive (with rare exceptions) can give more than *general* supervision to the creation of good public relations for his company? ..... NO

Is the economic status and viewpoint of major executives *usually* such as to permit them to clearly appreciate the "common man" viewpoint? ..... NO

Are the social contacts of major executives *usually* such as to give them a good cross-section of public likes and dislikes?..... NO

Is it sound to conclude that the publicly announced favorable viewpoints of luncheon clubs or other organizations composed largely of business men reflect the viewpoint of the public at large? ..... NO

After all, doesn't what *the most customers think* determine whether a public utility's public relations are good, fair, or bad, and aren't many of the public utility's public relations problems the result of affronts, real or imagined, to obscure customers?..... YES

Can spasmodic efforts at creating good public relations be permanently effective? ..... NO

Can haphazard, uncoordinated public relations activities get results as good as a coordinated, planned program? ..... NO

Should a permanent, continuous, coordinated public relations program be considered in the same light as casualty insurance—a precaution to lessen the effects of future damaging events?..... YES

Are good public relations of major importance to a public utility company? ..... YES

Can merely talking about creating good public relations—lip service—be very effective?..... NO

Admitting the correctness of the answers to the preceding two questions, should there not be in every company of large size an executive with "common people" background, experience and viewpoint, whose *sole* responsibility should be to direct and coordinate a program to maintain or create good public relations?..... YES

Should this man spend most of his time in the field, and have capable assistance to conduct the office routine? ..... YES

Should the counsel of such a man be sought as to probable reaction to company policies and activities *before* such policies are announced or activities are engaged in? ..... YES

What Type of Man Would This Be?

He would be the kind of man to whom the title of Executive Assistant would not cause him to forget his common-man viewpoint, or that he was selected to reflect that viewpoint. He would be of the type to inspire the confidence and ease of the lowliest employee, so confidences would be freely expressed, and so that he could, if the occasion warranted, offer friendly counsel to the employee. Lest the public relations activity might be misinterpreted to mean political activity, *he would be neither a politician nor the relative of a politician, and his duties would not require him to engage in political activities.* He probably would not be a specialist in law, engineering or finance, because these professions frequently inspire viewpoints not in consonance with the primary one in a public relations program, viz.: "We must conduct ourselves and our business in the manner our customers will like, to the extent that we can and still remain in business." Perhaps a sales background would be among the qualifications of this man, not that he would be expected to participate in the sale of merchandise, gas, electricity or water, but because a successful salesman knows that the first requisite of success with his customers is to cause the customer to like him, and to present ideas that are beneficial to the customer and thus cause the customer to become in accord with his viewpoint. Perhaps if this man had some experience writing readable, human-interest, informal advertising, that might be a point in his favor. Certainly he should be a man with personal habits and personality such as to inspire a spontaneous feeling of confidence. He should certainly not be the type of person with the sly, furtive air that comes from living too long with secrets. *He would be a man who would be expected to and would not fear to express a viewpoint at variance with that of the chief or general executive when some subject on which he is qualified to speak was under discussion in executive councils,* but who, should his viewpoint not prevail, would to the best of his ability follow the course determined. He would, *above all, be taken into the complete confidence of the management.*

What Kind of a Program

What kind of a program would this man have suggested to him by the public utility which decided upon a course of creating good public relations in a coordinated manner from the roots up, rather than from the foliage down?

It would be the kind of program suggested by the answers to the questions listed in this paper and perhaps others that might present themselves in specific organizations. It would be the kind of program prompted by the willing admission of weaknesses suggested by these questions and answers, should they exist in a company's present approach to either the problem of creating good public relations or that of neutralizing the effect of an adverse public attitude. It would be a *permanent, long-range program.* It would be a program based on human nature and not on abstract formulae. It would be a program that no "investigating committee" could besmirch—a program that any utility could proudly proclaim if boasting about one's good public relations program and the results thereof were not so apt to invite lightning to strike the boaster.

Exposition in this paper of what the questions and answers suggest seems unnecessary. Intelligent, open-minded consideration of them will suggest the lack of a program, or weaknesses or paradoxes in the existing public relations program of the individual public utility. To decide to inaugurate a program to create good public relations, or to eliminate weaknesses or paradoxes in a present program can be accomplished only by executive determination—a determination to stick to the corrective measures—a determination to make it somebody's special responsibility to assist the management in seeing that the new program does not fail because of lack of coordination and direction, and who would bring to the management's attention developing situations as to personnel, policy or company activities potentially harmful to the high public regard so earnestly desired by the company.

C. P. & L. Advertisements

"THE Carolina Power & Light Company has been running a series of newspaper advertisements which have attracted general attention among utilities. The ads were drawn up, and the campaign outlined by Joe Jarnigan, formerly of Chattanooga. These advertisements give the public credit for bringing about a rate reduction instead of picturing the utility as a Santa Claus or indicating that the reduction was brought about by pressure. It is said that this feature was employed for the first time by any utility in this series.

"The new rate schedule of the Carolina Power & Light Company, by the way, reveals that the top price of electricity to domestic consumers is only a nickel for the first 50 kwh used, exactly one-third of the rate charged in 1915, and only half that charged just a few years ago.

"The advertisements are illustrated with attractive photographs of housewives and home owners, exulting over the new slash in electricity rates and predicting wider use of electrical appliances therefrom."—*Chattanooga News.*

H. M. Byllesby Prize Paper

Reasons for a Retirements Reserve

By H. O. Hussong

AN electric utility is a continuing business. In a maintained continuing business depreciation of the whole due to wear and tear or exhaustion of capacity for service appears not to occur to a material degree.

In the mind of the public, who are the users of utility service, the controlling factor in connection with accounting for depreciation may be expressed by this question:

"Is this being done to our advantage as rate payers?"

Before this question can be answered two, and only two, facts need to be determined. These are:

(1) What it actually costs the utility, under current methods of operation, to keep its facilities in a high state of repair and efficiency, and

(2) If this cost is greater or less than the amount customers are paying for this purpose.

In addition to requirements by Commissions that sufficient income be appropriated for an adequate Depreciation Reserve, those Bodies are commonly empowered to designate the formulae to be used in determining the amount to be set aside. Methods in use are varied in their application, but all have something in common.

This common factor is an estimate, in years, of useful life which items or units of equipment will have under normal service conditions.

Electric utilities are composed of many different sorts of equipment, each of which may be made of different materials and each of which may have an individual estimated lifetime in useful service and corresponding salvage value. For these reasons it is necessary to estimate not one period of service applicable to the whole, but as many different periods as there are classes of equipment or kinds of materials. These different periods may be set up in columnar or tabular form, thus creating a "life-table."

However justifiable any so-called estimate may appear to be, it generally has been weighted by any geographical, climatic, physical, or other modifying characteristics. Hence, we may have different life-terms of service expectancy for identical equipment in different localities, or perhaps in the same territory but under different service conditions. In other words, the stated life expectancy of any item or unit of equipment appears to be dependent principally upon the human element, which is more or less nonsensical.

MR. HUSSONG

Mr. Hussong is the winner of the 1937 First Byllesby Award.

Mr. Hussong is employed as a statistician in the general office of the California Oregon Power Company at Medford, Ore. He was educated in the elementary public schools and at Franklin Academy in Franklin, Nebr. He came to Oregon in 1915, locating at Astoria. After serving with the American Army in France during the World War he came to Medford in 1922, entering the employ of the California Oregon Power Company and he has been with the company since that time.

Even if this life-table be qualified by the term "estimated," authorities have held it to be of little, if any, value. In New York and Queens Gas Company v. Newton (269 Fed. 277; aff'd. 258 U. S. 178) the Court said:

"From the testimony given upon the trial, I was strongly impressed that, in respect of a very large proportion of gas property, there is no ascertainable 'life expectancy'."

Again:

"It is difficult to characterize this (estimates on a life-table basis) by any other term than mere guesswork."—Havre de Grace and P. Bridge Co. v. Towers (Maryland Ct. of Appeals; 103 Atl. 319; P.U.R. 1918 D. page 484).

After requiring the use of a life-table most Commissions compound the error by denoting the method or formulae by which calculations shall be made.

Study of many accounting classifications promulgated by Commissions indicates that generally the sinking fund method or the straight-line method is the required procedure, although there is a minority of progressive Commissions which permits the utility to choose its own method, but the adoption of which depends upon the subsequent approval of the Commission.

The formulae and arithmetical computations necessary in the adoption of either the sinking fund method or the straight-line method are too well known to require exposition. It is sufficient to state that any such plan springs full-grown from a life-table. Many progressive utility executives question the wisdom of this procedure, but just so long as Commissions are shackled by precedent the life-table will be the prevailing base, however vulnerable to criticism.

Generally, it is true that future performance can be estimated reasonably if known facts as to the past are used as the basis for the forecast, but utilities rarely are permitted such a simple and elemental procedure in accumulating their needs for depreciation. Rather, such accruals are held fast by the weight of precedent to mathematics based upon an estimate of the number of years during which equipment is expected to provide satisfactory service, regardless of the voice of experience.

It is true that the life-table is regarded as an experience table. Equally, it appears true that the aggregate value of retirements made because of deterioration due to useful service is so small compared to the total retirements annually made by utilities as to be but a negligible fraction of such total retirements. In other words, the large majority of retirements are not made be-

cause the equipment has been worn out but because supersession is necessary due to obsolescence or inadequacy. That is the "voice of experience." Most equipment simply is not given the opportunity to prove that a stated estimated lifetime in service is approximately equivalent to its realizable term. Any utility that has been operating a sufficient number of years to constitute a reasonable cycle should be able to prove the contention that supersession and replacements because of either obsolescence or inadequacy have been the reason for a large majority of all past charges against any amounts reserved for depreciation.

In view of this condition, it is a fallacy to attempt to accrue a Depreciation Reserve by formulae based upon estimates which relate to a minor fraction of the equipment involved. Actuarial tables are not based upon a minority. Why, then, should tables purporting to represent the useful life of copper and porcelain and steel and like materials be the subject of such absurd discrimination?

Currently required methods bring to mind an unforgotten poem in which is described a remarkable one-horse shay which gave unexpected years upon years of satisfactory service, but suddenly disintegrated as though it had been the subject of a direct hit from "Big Bertha." Life-tables appear to presuppose that exactly similar conditions exist in utilities, and, upon some designated day in the future, each class of equipment — production plant — transmission lines—structures of various kinds—will suddenly become useless. Saving acts of God, this is impossible.

The one-horse shay was a composite, functioning group of many parts. Each of these parts was subject to wear in use—i. e., true depreciation. But if each of those wearing parts (naturally wearing unevenly) had been replaced in kind as it reached a reasonable exhausted "capacity for service," or had been superseded by better materials, that old one-horse shay might be giving satisfactory service this very day, at its ultimate capacity. Replacement in kind or supersession by better materials of each wearing part as the need arises makes possible a surprising lifetime for any functioning whole composed of units of wood, or metal, or stone, or any possible combination of such materials.

Electric utilities follow an identical maintenance program which represents replacement in kind or supersession by better materials of all wearing parts. But such utilities go much further than adequate maintenance. Equipment is retired from service whenever obsolescence occurs, regardless of its remaining serviceable life. Such obsolete equipment is not a total loss, of course; usually it is returned to service under conditions for which its design is adequate.

In this way utilities are capable of a perpetual useful life. Using an electric utility as an example, the enterprise constitutes a whole which never wears out. It was planned as a continuing business; not planned to give service for a predetermined period. Being planned as a continuing whole, thought was given to adequate maintenance; i. e., replacement of wearing parts.

It is obviously absurd to infer that, at the end of some stated period, such an enterprise will disintegrate as did the one-horse shay. The self-evident fact that such disintegration cannot happen should be acceptable proof that unrealized depreciation related to the business as a whole is simply non-existent except to a very minor degree. Rather, it would seem that *depreciation can be measured only as retirements are recorded.*

In the final analysis, unobserved or unrealized depreciation is the keystone of the whole Depreciation Reserve structure. Without this component the whole peculiar archwork falls to the ground.

That it is a fallacy is plainly ascertainable from the record.

When, in the history of the electric industry, did any utility, if properly maintained, fail to give adequate service up to its designed capacity, unless because of conditions beyond its control? If a single instance may be cited, then a modicum of facts might be uncovered to support the idea that it is necessary to accrue against sudden disintegration caused by failure of wearing parts.

On the other hand, if no single example can be discovered, then the whole Babylonic Tower of sinking funds, straight-line accruals, annuities, and diminishing balances falls to the ground—where it apparently belongs.

Disregarding acts of God, strikes, and conditions of war, all records at hand disclose that in no single instance has an electric utility, if properly maintained, failed to "deliver the goods," provided only that sufficient stand-by service has been available to carry a share of the load while maintenance work was being done.

Where, then, is this element of unobserved depreciation? Why, then, is it necessary that huge amounts of income be thrown into an almost bottomless reservoir of sinking funds or annuities in order to be able to pay for a disintegration that will not and cannot occur? *Of what are Commissions afraid?*

As a simple example, imagine a bridge; of any type or length; piers and girders of any material fancied; constructed for any purpose—say, as a connecting link in some great carrier system. Parts—the wearing parts—of such a bridge may fail because of age, climatic conditions, or other causes. But, is it not logical to conceive of this bridge being capable of an indefinite number of years in service, always up to the safety factor of its design, providing those wearing parts are replaced promptly as the need arises? If a bridge is treated as a continuing whole it need never become unsafe, need never fail. Under proper management when a cable reached its dotage (if ever) it would be replaced; if a pier developed faults under the strain of use it would be rebuilt; if hardware became unduly affected by natural elements, that hardware would be replaced or superseded. After fifty years of treatment as a continuing business it is quite possible that not one girder, not one plate of the original structure would be in use, but the bridge itself should be giving exactly the same service as on the day it was completed.

As a continuing business that bridge is not subject to any professorial monkey-business something after this well-known pattern:

"Each part of your bridge has an estimated life, after considering the different materials involved, of a certain definite number of years, because of which there should be set aside a certain sum of money each year so that as depreciation occurs, there will have been reserved funds which, added to the salvage recovered, will replace the structure. But before we decide definitely we will look in the book and discover what so-and-so says about the life of a bridge."

Transportation could depend on such a bridge. If so, it would be adequately maintained. Furthermore, at the end of any predetermined-by-slide-rule number of years, the bridge should be in adequate operating condition, but under present practice, management dutifully would continue earmarking income against its replacement, in the meantime spending other portions of income annually for maintenance. Finally, the

Reserve could become equal to the investment. Is this a desirable situation?

Exactly as represented by such an ordinary bridge, electric utilities are continuing businesses. Adequately maintained they will continue until a better economic pattern becomes evident, if there be one.

A generator, like a bridge, is composed of wearing parts. Adequate maintenance with an occasional overhaul is all that is necessary to keep a generator in active service for an indefinite period. Machinery, made from steel or bronze or any other material, does not wear out if adequately maintained. Obsolescence may occur, it is true, but if the wearing parts are replaced as needed a machine can last indefinitely. If Quintus Marcuis, in 144 B. C., had constructed a gas plant or an electric generating station instead of the aqueduct which still serves the city of Rome, that plant or power house could still be giving the same satisfactory service as on the first day it was successfully operated, provided only that it was not neglected. 144 B. C. was over 2,000 years ago. If properly maintained, how much of a Depreciation Reserve against replacement of a generator should be accrued in *twenty centuries?*

Obsolescence? Yes, that is another matter. But true depreciation, i.e., "exhaustion of capacity for service," occurs to a continuing business as a whole only when maintenance has been long deferred or downright neglected.

Underground structures and conduits underneath the city of Paris are affording satisfactory service now, although more than centuries old. This is a situation analogous to present day installations of many kinds.

For example, let us say that those structures and conduits were installed yesterday by private investors as a sewer-service project, the accounting for which is under direct supervision and regulation by a State Commission which requires the accrual of a Depreciation Reserve by the straight-line method.

Someone in authority states, after research among the published opinions of various self-starting economists, that this particular installation should be given an estimated life of one hundred years' capacity for service. Upon what this life is based may be a mysterious secret to officials of the utility. Nevertheless it is set up in the books of record as the maximum life expectancy and the accrual dutifully made.

To simplify the example no salvage will be assumed. Therefore, at the end of one hundred years, the actual amount earmarked as a Depreciation Reserve will equal the installed cost of the equipment. At the same time, will it suddenly become useless?

If these were true conditions under which operations are carried on, well and good. The corporation replaces the installation with a new complete unit. The Depreciation Reserve is adjusted. A new start is made. The same conditions are repeated every cycle of one hundred years.

Were it not for the fact that management of such corporations is vested in men trained in public service, the theory is ideal. But such trained executives strive for unimpaired service.

Under sound policies adequate maintenance is forecast and provided for in the rates. Not only is it provided for in the rates, but the money actually so collected is expended for maintenance. Sections of sewer "worn and torn" or "exhausted in their capacity for service" are replaced as needed. In the eyes of capable management, the installation is treated as a serviceable whole composed of replaceable wearing parts.

Hence, at the end of the century the service condition of the installation as a whole should be impaired but little, if any. Common sense indicates that the utility never should have been compelled to earmark any material portion of its income as a Depreciation Reserve. The contingency has never arisen; most of the Reserve should be rebated because it has been an overcharge, a portion of which is, in the premises, ninety-nine years delinquent. Now if the Depreciation Reserve were to be deducted from the investment would the remainder represent the per cent condition of the property, as it should?

Absurd assumption? Not at all—the sewers of Paris are centuries old and still in service. There is a cast iron water main in Ehrenbrietstein, Germany, that is 210 years old, in good condition, and still in service.

In the cold light of reality any appreciable earmarking of income as a trust fund held against depreciation of a continuing business does not appear to be justifiable. The major portion of such a trust fund, or reserve, approaches confiscation; arising, perhaps, from the forcible collection of an overburden in the form of rates; perhaps, from a forcible withholding of rent for the hire of capital; perhaps from the apparent necessity of paying inadequate remuneration to personnel. Or it might arise from any combination of these three conditions, or others.

Depreciation rules as applied to public service corporations disregard operating facts. Maintenance costs and retirements losses are ascertainable. The reality of such annual costs may well replace the guesswork of an accrual for unobserved depreciation. Before this may be done, however, operating realities must replace precedent.

In the Illinois Bell Telephone Case (1934) 292 U. S. 151, 78 L. ed. 1182, 3 P.U.R. (N.S.) 337, 348, 54 S.Ct. 658, Mr. Chief Justice Hughes used these pertinent words:

"The predictions must meet the controlling test of experience. In this instance, the evidence of expert computations of the amounts required does not stand alone. In *striking contrast* is the proof of the actual condition of the plant as maintained." (Emphasis my own.)

It has been stated that the large majority of retirements, other than that arising from the replacement of minor parts, are due to supersession because of obsolescence. Supersession is necessary because of inadequacy of capacity, improvement in design, advancement in the art, or for other similar reasons. This sort of replacement does not occur because equipment wears out.

Supersession, in the opinion of the writer, is not a reasonable charge against the present nor is it an equitable charge against the past, but it appears to be something for which the future should pay. In other words, it should pay for itself, either in increased business, less costly operation, or in other ways subsequent to the replacement. What is the economic reason for continuing any reserve policy which charges to business presently connected the cost of any advantages which may arise in the future because of replacement due to obsolescence? Yet under either the straight-line or the sinking fund method of accruing a reserve for depreciation, past business already has paid a major fraction of the costs of supersession. This appears to be, in the final analysis, a subsidy which is neither necessary, equitable, nor intellectually honest.

Large amounts representing replacements of this nature properly could be placed in a deferred account and written off periodically against realized economies or increased business, as either or both occur. These represent the reasons for supersession in the physical structure

of any operating utility and they should be held as strictly accountable.

Current practices of accruing a large Depreciation Reserve against future contingencies involve, directly, the vital question of rates. Rates may not be passed over by the remark that they rest in the hands of a regulatory body, whose sole responsibility they are. It is the paramount duty of management voluntarily to reduce rates whenever, wherever, and however possible. As a factor in rates, the practice of earmarking an unduly large portion of income as a Depreciation Reserve is worthy of serious attention.

If rates are such as to provide all costs including sufficient income to accrue a Depreciation Reserve based upon either a sinking fund or a straight-line policy there is no reason why a public service corporation may not appear on its own motion, before its Regulatory Commission, asking for a change in practices backed by a promised rate reduction. Such a reduction should approximate the difference between weighted annual maintenance costs plus retirements losses and the sum currently required to be appropriated for the Depreciation Reserve. All costs being met, this difference is an overburden on the customers.

If rates are adequate to cover all operating expense including a Depreciation Reserve computed by sinking fund or straight-line formulae but insufficient to permit a reasonable payment of rent for the hire of capital there can be no logical demand for rate reduction. However, it appears to be in order to make an appearance before a Commission asking for such a change in appropriating for the Depreciation Reserve as will permit a resultant reduction in operating expenses, such savings to partially, or perhaps fully, recompense investors or shareholders for what, under such conditions, is but income forcibly withheld from them. Naturally all sums over sufficient to fully recompense investors or shareholders in such a case could be the basis for voluntary rate reductions.

The above hypothetical examples apply primarily to utilities which are plagued with little or no trouble from the employee standpoint.

The history of the carriers is interspersed with tie-ups and service failures due to dissatisfied employees. The merits or demerits of such dissatisfaction are not under discussion. Sufficient is it to state that were not the carriers compelled by regulation of quasi-public bodies to create huge Reserves for depreciation there might possibly be sufficient income to adequately cover maintenance costs and retirements losses on an average annual basis plus amounts which might equitably be used as a fund for distribution between rate-payers, employees, and owners.

Contented personnel is one of the most important and active factors of successful utility operation. There can be no beneficent public relations if employees are disgruntled. Other means being lacking, here is an untapped source of funds with which to maintain an equitable balance between the hire of labor and the hire of capital.

On Page 56 of the *Electrical World*, January 2, 1937 issue, it is stated that 38,357 thousands of tons of coal and coke were consumed in 1936 for the generation of electricity. This, by itself, means very little in relation to depreciation. But, following the thread of thought, it becomes apparent that this enormous tonnage was hauled; that the majority was hauled by common carriers; that those common carriers are compelled to build up huge depreciation accruals based upon professorial formulae; that the cost of such hauling includes a percentage representing this unnecessary Depreciation Reserve, and that, eventually, the rate structure of the electric utility using coal as a means of generation would be affected were it possible to reduce fuel costs by a portion of this charge;—to say nothing of the rates of gas utilities dependent upon coal or its products.

In addition to such a result, perhaps small on an individual basis but in the aggregate for a continuing business constituting an appreciable sum, there immediately is opened up an added vista of increased use because of changed rates, which is accumulative and cannot be estimated.

The fact that many electric utilities are to some degree dependent upon coal deliveries is a simple example of the manner in which currently required policies of accruing for depreciation are pyramided, hitting the customer, the investor, and the employee in his most vulnerable spot,—his pocket-book.

The procedure of changing from a Depreciation Reserve basis to a Retirement Reserve basis is relatively simple.

A review of retirements losses (excepting, of course, supersession of any magnitude) over a reasonable period results in a statement which represents the costs to the utility of "exhaustion of capacity for service"; in understandable words: what losses have been realized as retirements have been recorded. For the same period the total number of service-units sold is as readily obtained.

Division of the retirements losses by the number of service-units sold would result in the average retirements loss per service-unit sold.

This average would be multiplied by the total of service-units which it is estimated will be sold in the ensuing period. The result is an amount which logically represents the estimated Retirements Reserve necessary to be appropriated from income for that period after giving due consideration to known factors which may affect the future.

Maintenance costs would be carefully scrutinized. Replacements and renewals deferred in the past would be budgeted immediately. As expenditures for such accounts are made they would be charged against existing Depreciation Reserves.

The remaining balance in any existing Depreciation Reserve would be transferred to a deferred account from which appropriations for extraordinary maintenance could be made as needed. Indeed, carried to its logical conclusion, no appropriations need be made from income for retirement purposes until such a deferred account is reduced to a reasonable balance estimated to equal the difference between one hundred per cent and the present condition of the tangible operative property. *The sum of all losses arising because of past operations possibly cannot be greater than this difference.*

Capital expenditures arising from supersessions due to obsolescence, in any of its meanings, if of sufficient magnitude would be offset by a deferred credit account to be written off as the expected economies or increased revenues materialize, thus placing their cost apparently where it belongs—i.e., against future business.

After the change-over to a Retirement Reserve policy all maintenance should be cared for out of current income as the need arises, and, a most important factor, maintenance should be adequate.

Deferred maintenance occurs generally only when current income is insufficient to pay the costs. Under a Retirements Reserve plan current income available for maintenance should be sufficient to cover all necessary expenditures be-

cause such income would be increased by the difference between the sum currently earmarked as Retirement Reserve and what was formerly earmarked Depreciation Reserve.

Retirements losses vary somewhat from year to year, but over an extensive period they should be found to be reasonably close in the aggregate to the result of multiplying the total service units sold by the previously calculated cost per unit. This appears true because comparable wearing parts in any stabilized operation should wear in a reasonably similar manner in respect to time of use and recoverable salvage.

Under a Retirements Reserve policy it is conceivable that at the end of an accounting period the reserve might reflect a small debit instead of a conservative credit due to such fluctuations. Such a debit is no reason to "view with alarm" any more than present large credit balances are reasons to "point with pride." Succeeding accounting periods should restore the retirements reserve to a normal small credit balance.

The advantages of such a system are not only simplicity and flexibility, but a much nearer approach to accuracy because a Retirements Reserve is based wholly upon the realities of experience rather than the vagaries of unsupported, uneconomic precedents.

Also, there is no opportunity such as now exists for a distortion of the balance sheet by reflecting a huge Reserve for wear and tear or sudden exhaustion of capacity for service of a major fraction of physical property (disintegration, if you please) which, because of the parallel program of adequate maintenance, will not and cannot occur.

Not only is a huge Depreciation Reserve balance a distortion of fact, but it creates a dangerous situation.

A notable example is the Chicago Telephone Company Case (P.U.R. 1924 A, page 213). In this case the published Balance Sheet of the Company reflected a Depreciation Reserve amounting to approximately 50 per cent of the investment claimed as dedicated to the public service.

The Commission arbitrarily reduced the investment by an amount approximately equal to the stated Depreciation Reserve, apparently believing that the customers should not be compelled to pay rates adequate to enable a return on property they had purchased from the Company by paying for depreciation that had not been realized.

I hold no brief for either the Commission or the Company. But it is apparent that the Company, by publishing such a Balance Sheet, placed themselves in a cul-de-sac from which there was no opportunity to retire. Their own Balance Sheet was a stout champion representing the Commission.

Had the Company been operating under a logical Retirement Reserve policy based upon the realities of experience there could have been possible no Balance Sheet reflection of a Reserve approximately equal to 50 per cent of the investment. Hence, the Commission would have had not even a visual justification for deducting the Reserve.

Some twelve years later, the *Morning Oregonian,* Portland, Oregon, printed on page 3 of the issue dated January 15, 1936, the following story:

Reserve Target in Phone Hearing

Excessive amounts which the Pacific Telephone & Telegraph company was accused of having drawn from revenues for the accumulation of depreciation reserve formed the target of Alfred P. Dobson, attorney for the public utilities commission, at the resumption of the telephone rate hearing Monday at the Multnomah County courthouse. The telephone company is seeking to have a rate reducing order of the public utilities commission set aside.

Mr. Dobson told Circuit Judges Tucker, Lusk and James T. Brand of Marshfield, sitting en banc, that the telephone company had accumulated approximately $6,000,000 in reserves from 1918 to the present time.

"This becomes a part of capital on which they want the customers of the company to pay them their sacred 7½ per cent return." Mr. Dobson declared.

Fair Return Target

Dobson said that in many instances the company's property had been paid for by amounts drawn from revenues and charged to depreciation reserve. In spite of this fact, he pointed out, the telephone company still wanted to get what it declared to be a fair return on its investment.

The hearing recessed Monday night until today to give Dobson opportunity to prepare further argument.

In between these two hearings numerous instances might be cited in which a huge Depreciation Reserve actually has been used as ammunition for a direct assault against which the utilities bear the burden of defense; but if operating under Regulatory Body supervision, are culpable only in part.

Depreciation funds often are ploughed back into the business. This is, in fact, borrowing funds for capital expenditures which have been collected in the name of replacement funds. Capital expenditures imply more customers who in turn contribute funds for replacement purposes which funds are borrowed to fund construction, implying more customers, ad infinitum, ad nauseam.

Passing over the ethics of such a peculiar situation it is plain that the use of a Retirement Reserve instead of a Depreciation Reserve would remove this source of criticism since at no time would the balance in the Retirement Reserve be of such magnitude as to require any special need for its investment nor large enough to finance much construction.

The Texas Railroad Commission re M. & M. Pipe Line Company, is quoted on page 256 of *Public Utilities Fortnightly,* issue dated January 30, 1936, in part as follows:

"* * * * * there is no rule or reason why the consumers should pay a rate that will permit the company to keep its property in good operating condition and also accumulate an excess in that fund to be retained by the company or paid out in excess dividends or FOR OTHER PURPOSES." (Emphasis mine.)

Is it possible that here is a commission beginning to look askance upon the practice of funding construction by borrowing from a Depreciation Reserve without the propriety and formality of issuing bonds or junior securities?

An interesting indication of the beginnings of a trend in the right direction is revealed by General Order No. 59 of the Nebraska Commission in 1935 in connection with the Northwestern Bell Telephone Company hearing.

In this case the majority of the Commission expressed an opinion that there is no better test of depreciation than experience and that the balance in the Depreciation Reserve should be considered as an indicator of accrued depreciation.

Commissioner Bollen, speaking for the majority, said in part:

"We now hold that the experience of a single year does not form a sound basis for estimating future depreciation rates. On the other hand we hold that company's actual experience with retirements covering a period of time which equals or approaches to an average turn-over or cycle of all depreciable property, forms a sound basis for estimating future rates."

Apparently both a telephone company and a Commission have been acquiring something of an education since the Chicago Telephone Company Case in 1924.

When management collects, as a percentage of rates, a certain amount earmarked for the Depreciation Reserve it assumes a definite obligation, which may be stated simply as follows:—"Your service will never fail nor suffer impairment, unless for reasons unforeseen and

(Continued on page 352)

McGraw Prize Paper

A New Method for Checking Instrument Transformer Connections to Watthour Meters

By Wallace C. Rudd

THE method to be described consists of the use of a phase angle meter to measure the phase difference between the voltage and current applied to any element of the watthour meter. From readings taken on the several elements and between elements the vector diagram of the metering circuit may be drawn. This diagram may be analyzed to determine any errors in connections.

In measuring the phase angle between a current and a voltage the phase angle meters requires a connection to the potential supply and a connection in series with the current, the pointer indicating directly the angle in degrees over the entire 360 degrees. In checking connections on a permanent watthour meter installation whose current coils are fed from current transformers, it is often impractical to connect the phase angle meter current coil in series with the watthour meter current coils.

The problem then is how to get a current in the phase angle meter current coil which is proportional to and of the same phase, or differing by a constant phase angle from that in the watthour meter current coil, without actual connection. The potential coil of the phase angle meter is connected directly to the potential terminals of the watthour meter.

This is accomplished by using a split-core current transformer which is operated open circuited. Thus in reality it becomes a potential transformer. This transformer is clipped around the wire leading to the watthour meter current coil making it similar to a through type current transformer. With current flowing in the coil of the watthour meter a voltage will be induced in the secondary of this testing transformer, which is proportional to the primary current and at a constant phase angle to it. This holds true if no load is applied to the secondary. This testing transformer is designed so that the open circuit voltage will have a value of about 10 volts when five amperes pass through the primary.

The secondary of the testing transformer is then fed into the grid circuit of a vacuum tube power amplifier. The amplifier is designed to feed into the low impedance load of a phase angle meter current coil and an ammeter connected in series.

MR. RUDD

Mr. Rudd is the winner of the Second James H. McGraw Prize for 1937.

Mr. Rudd was born in New York, N. Y., in 1910. He received the degree of Electrical Engineer from Rensselaer Polytechnic Institute in 1933. The same year he entered the employ of the New York Edison Company. In 1936 he was transferred to the Test Bureau of the Consolidated Edison Company. Mr. Rudd maintains a private laboratory for varied experimental work, particularly on general testing methods and power equipment.

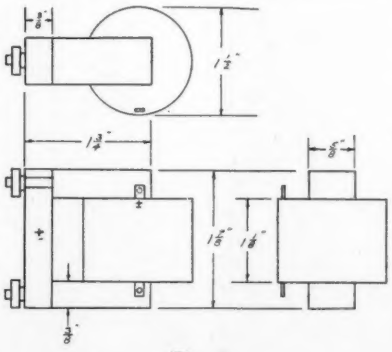


Fig. 1

This results in a current in the load circuit of approximately 1.5 amperes with 5 amperes flowing in the primary of the testing transformer. This amplifier load current is approximately proportional to the primary current and differs from it by a constant phase angle of approximately 90° lagging, or leading, dependent on connections.

The testing transformer consists of a laminated iron core in the form of a rectangle, one side of which is removable to permit its being clamped around the watthour meter current coil feeder. The secondary coil consists of some 25,000 turns of number 56 wire.

For ease and speed of test it is required to have a testing transformer for each element of the watthour meter that is to be tested. The usual number is three. A drawing showing the construction of these testing transformers is reproduced in Fig. 1. The testing transformers should be checked for polarity and the proper marking made on the terminals.

The amplifier which the author used consisted of a type 47 screen grid tube with a type 80 rectifier for the power supply. A diagram of the circuit and the values of the component parts are given in Figure 2. This circuit should not be taken as the ultimate. Other circuits can be used, some of which may be better. The dotted section of the circuit was used to prevent the amplifier from oscillating. This may not be necessary in another set up, as the input impedance may be of such a value that there will be no oscillation. The amplifier should be capable of delivering about 2 watts.

The phase angle meter for which this amplifier was designed was a Weston Model 480, which had a current coil resistance of 0.48 ohms and an inductance of 0.0016 Henry, giving an impedance at 60 cycles of 0.48 + j0.60 ohms having a magnitude of 0.77 ohms.

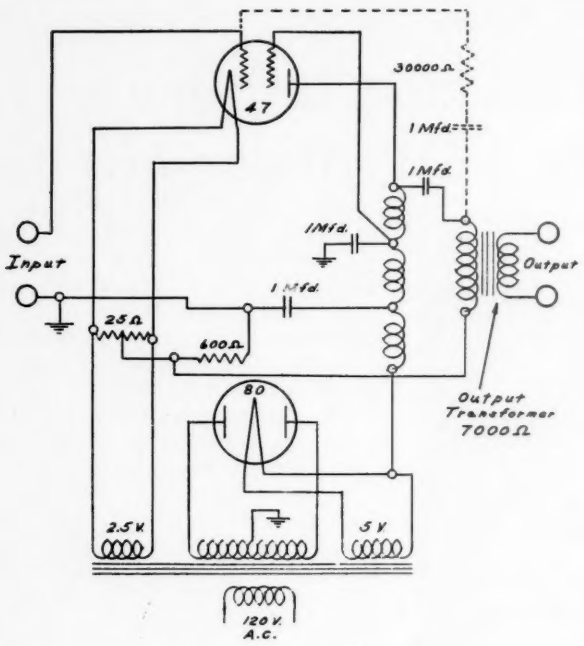


Fig. 2

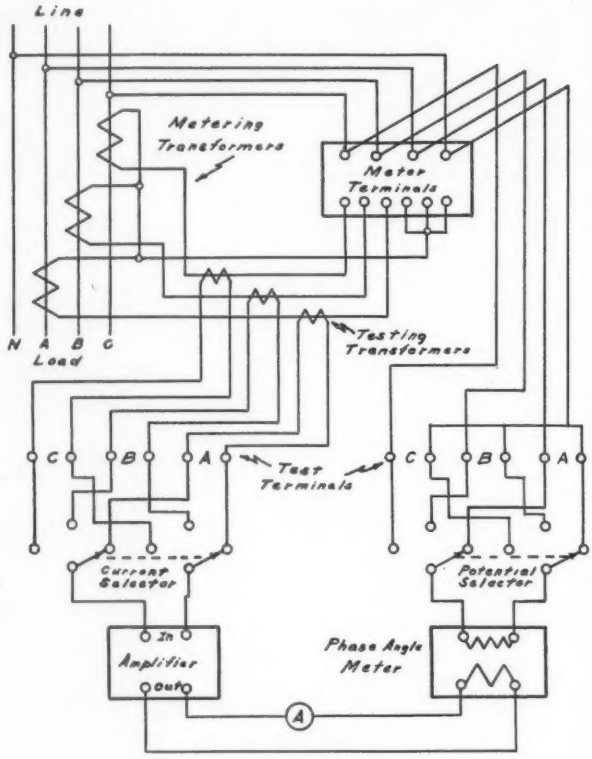


Fig. 3

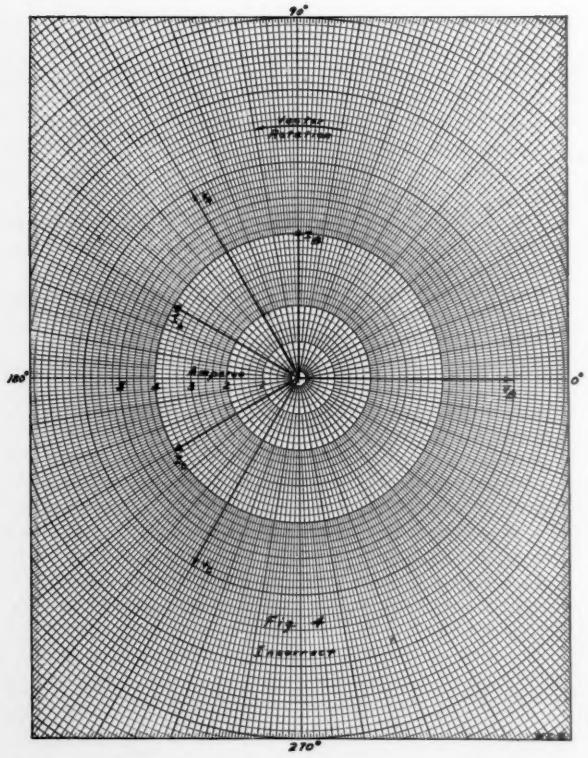


Fig. 4

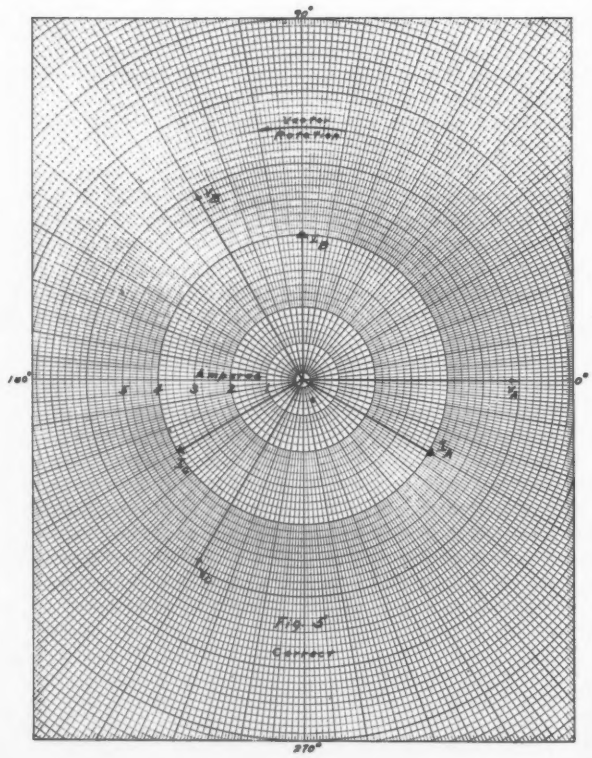


Fig. 5

This plus the ammeter impedance would be the load which is supplied by the amplifier. The ammeter should be of a low resistance type with a 2 ampere scale which can be calibrated to read in watthour meter current coil amperes. The amplifier output transformer should have its secondary coil tapped so that it can be matched to the load impedance.

In order to take readings between voltage and current on the several elements, some switching equipment is required. A complete diagram of the metering and test circuits for a three-element meter is shown in Figure 3.

A typical test on a three-element current transformer watthour meter would be conducted as follows.

The test outfit is set up adjacent to the watthour meter. No access to the metering current transformer is required. The leads from the potential terminals of the test outfit are connected to the proper potential terminals of the watthour meter. The testing transformers are then clamped around the current leads of the meter. Polarity markings should be carefully watched. For example, all polarity markings should go toward the main current transformers.

The potential selector switch should be set on voltage A. The current selector switch should be set on current A. The phase angle meter and ammeter are read and noted. The current selector switch is then set on B and a reading taken leaving the potential selector switch on A. The same is done for current C. This gives the magnitude and phase relation of all currents to voltage A. This procedure is repeated for B and C voltages. The phase relation and magnitude of all currents with respect to all voltages are then known. From these readings (nine in all) the vector diagram may be plotted and any errors in connections noted.

A typical set of readings for an erroneously connected watthour meter might be as in Table I. (The phase angle meter gives the angle by which the current leads the voltage.) (Shift through the amplifier equals 80° lagging.)

Load conditions (approximately balanced and at a lagging power factor.)

The resultant vector diagram is shown in Figure 4. From this diagram it may be seen that A current coil is reversed and A and B voltages are interchanged. These three corrections are made and another set of readings are taken as in Table II.

These readings give a vector diagram as shown in Figure 5, which is that of a correctly wired meter.

The time involved in taking these readings should not be more than two minutes so that a check, correction of wiring, and a recheck can be made in a very short time.

The same procedure is followed on two element meters. In this case it being necessary to take only four readings. The phase angle meter potential coil should of course be set for line to line voltage instead of line to neutral.

Variations in consumers load do not affect the phase angle meter reading as long as they are variations of magnitude only. Thus it is possible to check connections on a meter that has a continually varying load but of a constant power factor with ease and accuracy.

The complete apparatus would be in two units, the phase angle meter (weight 35 pounds) and the amplifier and switches (weight about 20 pounds).

The author wishes to express his thanks and appreciation to Mr. Robert L. Petersen of the Consolidated Edison Company for his advice in the design of the amplifier circuit.

TABLE I

Current Amperes	Angle Between Voltage	Angle Between Current	Reading Degrees	Correction For Shift	True Angle Degrees
4.0	A	A	310	+80	30
4.1		B	250	+80	330
4.0		C	10	+80	90
	B	A	70	+80	150
		B	10	+80	90
		C	130	+80	210
	C	A	190	+80	270
		B	130	+80	210
		C	250	+80	330

TABLE II

Current Amperes	Angle Between Voltage	Angle Between Current	Reading Degrees	Correction For Shift	True Angle Degrees
4.2	A	A	250	+80	330
4.1		B	10	+80	90
4.0		C	130	+80	210
	B	A	130	+80	210
		B	250	+80	330
		C	10	+80	90
	C	A	10	+80	90
		B	130	+80	210
		C	250	+80	330

Radio Interference in Great Britain

MANY complaints regarding radio interference are received by power companies. It has been several years since a study has been made in this country of the number and cause of these complaints for the entire industry. However, a number of individual companies have kept accurate records and although in general less than 20 per cent of the complaints are due to the power system many companies have found it necessary to investigate practically all complaints which are received. In Canada the question of radio interference is under the jurisdiction of the Department of Marine, which has trained investigators for locating the source of interference. In Great Britain these investigations are conducted by the Post Office Department, which has full jurisdiction over broadcasting and licenses receivers.

There are, at the present time, about 6,000,000 domestic consumers in Great Britain and the following, taken from the July 30, 1937, issue of the *Electrician*, shows the magnitude and extent of this problem in that country:

"In an answer to Col. Goodman, Sir W. Womersley, Assistant Postmaster-General, revealed that the Post Office spends £90,000 a year in assisting owners of wireless sets to obtain reception free from interference caused by electrical apparatus. The staff employed on the work of investigation numbers 250. More than 40,000 complaints are now dealt with in a year and the number of cases is growing steadily. Legislation is being prepared by the Post Office for the compulsory suppression of such interference. Listeners who experience the various kinds of noise caused by electrical apparatus can obtain the help of the investigation staff by filling in forms supplied by the Post Office. The investigator usually employs a portable set to trace the exact source of trouble."

Industry Accountants to Hold National Conference

An Accounting Conference of national scope will be held under the auspices of the Accounting Committee of the Institute, Bernard S. Rodey, Jr., Chairman, at Detroit, Mich., November 8-10, inclusive. It will be an all-industry accounting conference open to non-member companies, as well as to members of the Institute.

The purpose of the conference will be to bring before those attending, the most up to date information on accounting developments, particularly in respect to developments which have resulted from the adoption of the uniform system of accounts by the Federal Power Commission, The National Association of Railroad and Utilities Commissioners and by a number of state commissions. Although it is planned to give special attention to matters relating to Plant Accounting problems, considerable time will be devoted to a discussion of other important developments and changes which are taking place in general accounting activities.

In general, the conference will be conducted through informal "round table" discussions. Each of the major subjects will have a discussion leader who will bring the subject to the floor with a short historical statement based largely on "procedure" or "practice" rather than a theoretical discussion. It is believed this method of presentation will afford an opportunity for free discussion and exchange of viewpoint.

The first day, according to tentative plans, will be devoted to those subjects now being considered by specialized groups of the Committee and which might be discussed concurrently in separate meetings. These include:

a. Customer Relations, Commercial Accounting and Collections.
b. General Accounting and Records.
c. Payroll Accounting (including treatment of Social Security Accounting, Payroll Deductions, Pension Accruals, etc.).
d. Purchasing, Stores and Transportation (including coordination of stores classification for purchasing control).

An all-day general conference on Plant Accounting and related matters will be held on the second day. Mr. H. D. Anderson, Chairman of the Plant Accounting and Records Committee, and the members of his committee will conduct the round table discussion which will cover in a broad way the following subjects:

a. Original Cost Determination.
b. Consideration of Plant Adjustment and Acquisition Adjustment Accounts.
c. Depreciation Accounting Problems.
d. Retirement Units — Maintenance Replacements.
e. Treatment of Reconstruction Costs.
f. Treatment of Construction Overhead and Indirect Costs.
g. Transmission and Distribution.
h. Plant Inventory Problems.

The third day, Wednesday, Nov. 10, will be reserved for the conclusion of any unfinished discussion of Plant Accounting, and for discussion of at least two other important subjects including:

a. Cost Allocations and Accounting Allocations between departments in combination companies.
b. Development of job classifications in accounting departments and training of accounting personnel.

Mr. Rodey states that everything possible is being done by the Accounting Committee and others who are working on specialized subjects to make this conference interesting and instructive. A more detailed program will be given in a later issue of the BULLETIN. In the meantime, the Chairman of the Accounting Committee will be delighted to receive suggestions as to new outstanding accounting procedures or methods which might be brought to the attention of the accounting people at this conference.

New York World's Fair to Have Completely Electrified Farm

PLANS have been completed for the most completely electrified farm in the world, which will be on display at the New York World's Fair in 1939. The architectural firm of Harrison & Fouilhoux has been engaged by the World's Fair Committee of the Institute to design and supervise construction of an electric farm as part of the exhibit of the country's electric light and power companies.

"The electric farm will show every conceivable farm and home operation which electricity can perform," Mr. Harrison said in announcing the Committee's plans. "It will present a dramatic demonstration of the opportunities which electrical equipment offers for a vastly higher standard of living on the farm, an improved social status for the farmer and the members of his family, and a release from the back-breaking drudgery with which farming has always been identified.

With 1,118,000 farms in the United States now served with electric current, the application of these efficient and economical electrical conveniences and comforts has wide significance, Mr. Harrison pointed out. The electric farm demonstration area will comprise 32,400 square feet in the Shelter Section of the Fair. In addition to this, the electric companies will show in another area, elsewhere at the Fair, the newest industrial and commercial application of electricity.

In order that the farm may be in full operation when the Fair opens, the buildings will be completed, livestock installed and farming operations commenced months in advance of the Fair's opening date, Mr. Harrison explained. Dairy cattle, poultry and bees will be well settled in their homes and accustomed to their surroundings long before visitors to the Fair arrive. Crops will be growing and fruit trees established. In this way the farm will avoid any appearance of a static exhibit, and the daily farm routine will be in full swing.

Hens will work overtime in electrically-lighted laying houses. Cows will have their feed and water placed before them, and will be milked twice daily, by electricity. Hot beds, electrically heated, will sprout seed and grow tiny plants which will later be transplanted in gardens where overhead irrigation systems,

(Continued on page 352)

Central Station Voltages for Lighting

By G. S. Merrill
General Electric Company

NINETY-EIGHT per cent of the population in this country receiving Central Station service is now supplied at a nominal standard voltage of either 115 or 120.

The trend has been slowly but steadily upward, as shown below.

PER CENT OF U. S. POPULATION IN AREAS SUPPLIED AT DIFFERENT VOLTAGES

Voltage	1923	1928	1933	1936	1937
110	36.3	15.9	5.2	2.0	1.8
115	40.9	61.6	61.7	58.9	52.1
120	19.4	22.4	33.0	39.0	46.0
All Others	3.4	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0
Ave. Voltage (1st three items only)	114.1	115.3	116.4	116.9	117.2

It is interesting to note that for the last five years 120-volt service has been gaining at the expense of the two lower voltages. Two things seem to be contributing to this upward trend, namely, the increasing use of light, heat, and power which is putting heavier loads on residential circuits, and the installation of three-phase, four-wire 120/208 volt networks in commercial areas. It appears that many appliances in use on circuits nominally rated at 115, would give the customers more snappy and satisfactory service if the voltage delivered at the appliance could be raised five volts above its present level.

In the interest of good lighting service the utilities and the lamp manufacturers are generally trying to encourage the use of lamps whose labeled voltage corresponds to the average voltage at which they are operated. Lamps are designed to give the public the most satisfactory and economical lighting service when they are operated at labeled voltage. Although the amount spent by the customers for electrical energy and for lamps decreases when lamps are burned at a lower voltage, the light output in most cases diminishes more rapidly than the operating expense (current plus lamp renewals) and the customer pays more per unit of light.

The problem of keeping lamps of the correct voltage in the sockets throughout a community is rendered very difficult in case two standard voltages for light-

TABLE I—ANALYSIS OF LIGHTING VOLTAGE BY STATES

Division and State	Population of Cities and Towns Listed in Voltage Book	Ave. Voltage Weighted According to Population Served	Percentage of Population Listed in Voltage Books Served at 110	115	120	125	130	All Others*
New England								
Maine	751,400	115.4	8.1	74.8	17.1	..	..	..
New Hampshire	368,200	116.7	.9	64.7	34.4	..	..	..
Vermont	319,500	115.4	.7	90.9	8.1	.3	..	..
Massachusetts	4,151,100	115.1	4.0	89.7	6.3	..	..	..
Rhode Island	610,600	115.9	1.3	79.9	18.8	..	..	..
Connecticut	1,416,800	116.3	.9	71.7	27.4	..	..	..
Middle Atlantic								
New York	12,025,800	118.8	.8	22.2	77.0	..	..	..
New Jersey	3,834,700	119.3	..	14.5	85.5	..	..	..
Pennsylvania	7,740,400	115.3	.7	92.7	6.6	..	..	..
East North Central								
Ohio	5,272,500	115.9	.6	81.2	18.2	..	..	..
Indiana	1,843,400	116.5	4.6	62.3	32.4	.3	.3	.1H
Illinois	6,367,000	118.4	.7	31.4	67.9	..	..	..
Michigan	3,845,400	117.2	1.5	53.8	44.7	..	..	..
Wisconsin	2,054,300	117.4	1.6	48.5	49.9	..	..	..
West North Central								
Minnesota	1,644,200	116.3	2.2	71.2	26.6	..	..	..
Iowa	1,427,900	114.4	19.1	74.7	6.2	..	..	..
Missouri	2,258,800	115.1	.4	96.2	3.4	..	..	..
N. Dakota	269,000	115.6	1.0	87.1	11.9	..	..	..
S. Dakota	281,800	114.9	5.4	90.8	3.4	.4	..	..
Nebraska	719,100	116.9	3.8	56.2	39.9	.05	..	.05H
Kansas	1,022,100	115.5	2.5	86.3	11.1	..	.05	.05H
South Atlantic								
Delaware	166,200	118.9	.2	22.7	77.1	..	..	..
Maryland	1,204,400	118.7	.3	24.6	75.1	..	..	..
District of Columbia	486,900	115.0	..	100.0	..	..	..	..
Virginia	1,178,500	117.8	.5	42.2	57.3	..	..	..
W. Virginia	841,000	115.0	.1	99.5	.4	..	..	..
N. Carolina	1,088,300	117.5	4.3	42.4	53.3	..	..	..
S. Carolina	532,600	115.2	5.0	85.7	9.3	..	..	..
Georgia	1,146,900	115.9	3.5	74.2	22.3	..	..	..
Florida	953,300	115.4	4.9	82.1	13.0	..	..	..
East South Central								
Kentucky	1,037,400	117.0	7.2	43.7	48.3	..	..	..
Tennessee	1,132,900	115.4	3.4	84.8	11.8	..	..	.8L
Alabama	1,063,300	118.3	.6	33.7	65.7	..	..	..
Mississippi	555,900	116.0	.9	83.7	15.0	.1	..	.3H
West South Central								
Arkansas	575,200	116.0	2.9	77.5	16.0	3.6	..	..
Louisiana	992,900	118.7	1.3	24.5	73.9	.05	.25	..
Oklahoma	1,171,900	118.9	1.6	28.1	70.3	..	..	..
Texas	3,040,500	118.4	1.0	29.5	69.5	..	..	..
Mountain								
Montana	267,700	117.4	1.3	56.7	41.5	.2	.3	..
Idaho	221,000	119.4	2.8	5.9	91.3	..	..	..
Wyoming	120,900	114.9	16.0	71.5	11.0	1.5	..	..
Colorado	670,200	116.4	1.7	69.0	29.3	..	..	..
New Mexico	260,800	116.1	2.4	90.0	6.8	..	..	.8H
Arizona	239,400	116.1	13.8	51.3	34.9	..	..	..
Utah	417,500	119.5	1.2	7.5	91.0	..	.3	..
Nevada	65,300	114.3	14.2	85.8	..	..	..	..
Pacific								
Washington	1,189,100	119.9	.2	3.1	96.6	..	..	.1H
Oregon	649,200	119.9	.4	1.6	98.0	..	..	..
California	4,988,700	119.4	.2	11.3	88.4	.1	..	..
U. S. Total and Averages	84,481,900	117.22	1.81	52.11	46.00	.05	.01	.02

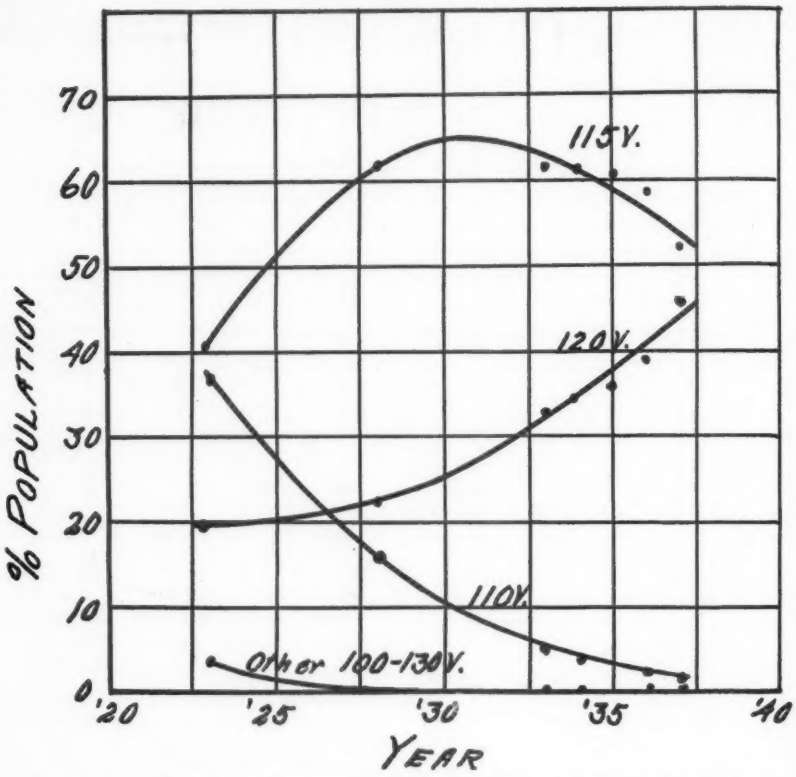
*H—Above 130. L—Below 110. Not included in average.

ing are in use—as where part or all of the business area is supplied at 120 volts and the residential area at 115. In such cases it might eventually be possible to bring up the 115-volt area to 120 and thus reestablish a single standard lighting voltage for the whole community.

Poor voltage regulation also contributes to undervoltage operation because lamps of voltages high enough to be used satisfactorily in the high voltage spots must be made available, and experience shows that these lamps will then get into many low voltage sockets.

While each company deals individually with its own local voltage situation, the problem has some aspects of national interest. For example, along the boundary line between systems operating at different voltages, there is a tendency for the higher voltage lamps to get into lower voltage sockets. Along such boundaries the distribution of proper voltage lamps is again rendered difficult. Inasmuch as practically all central station lighting is now supplied at either 115 to 120 volts, it might be possible with careful planning to eliminate this spread by bringing all 115-volt lighting up to 120 in the course of the next five or ten years.

With the improvements in voltage regulation that are now being attained the establishment of a single standard utilization voltage of 120 throughout the country would not only remove one of the greatest obstacles to the use of lamps at correct voltage, but it would undoubtedly react advantageously to all concerned in the design, production, distribution, and use of appliances and equipment on Central Station circuits.



Per Cent of Population Reported as Being Served at Various Voltages for Lighting—100-130 Volt Range.

Electric Buffet Entertaining Will be Featured in October

THE steadily increasing trend toward buffet entertaining will be officially recognized in October, with the selection of that month by the Electrical Housewares Program as *Electric Buffet Entertaining Month.*

The committee in charge of *Electric Buffet Entertaining Month* is preparing a 32-page book of table settings and menus which make use of the decorative beauty of modern electric grills, toasters, buffet service, coffee makers, roasters and other electrical table appliances.

Electric Buffet Entertaining Month will be announced nationally in *Better Homes and Gardens,* with full-page space in two colors. Cooperating manufacturers will follow this page with individual advertisements of their own products.

A contest will be sponsored on buffet table settings to be displayed either in the window or the interior of retailers' stores. A prize will be awarded to the best table setting submitted by the Utility group, Department Store group and the group comprising other retailers.

A Plan Book which explains the program for *Electric Buffet Entertaining Month* is being prepared. It will describe and picture broadsides, newspaper advertising mats, stickers, posters, counter cards and car cards, all of which will be available at production costs. Publicity releases are being prepared for local use.

Nationally-known home economists who are experts in electric cookery have contributed scripts for radio talks to the portfolio of broadcasts which will be offered as an important part of the program.

Dealers in electrical appliances who tie in with this national program will enjoy the full benefits of its nation-wide advertising and publicity, and the accelerated consumer interest which it generates. In addition they may make full use of the effective point of sales promotional material which has been prepared. These materials may be obtained through the local electric utility company, through any of the cooperating manufacturers, or from the Edison Electric Institute, 420 Lexington Avenue, New York.

Manufacturers cooperating with Edison Electric Institute in *Electric Buffet Entertaining Month* are American Electrical Heater Company, General Electric Company, Hamilton-Beach Company Division of Scovill Manufacturing Company, Landers, Frary & Clark, Toastmaster Products Division of McGraw Electric Company, Manning-Bowman & Company, National Enameling & Stamping Company, Proctor & Schwartz Electric Company, Robeson Rochester Corporation, Samson-United Corporation, Swartzbaugh Manufacturing Company, The Silex Company and Westinghouse Electric & Manufacturing.

Distribution Transformer Load Supervising Methods

By C. H. Lewis and E. H. Snyder
Public Service Electric & Gas Company

A paper presented before the Transmission and Distribution Committee, E.E.I.

THE loading of transformers in accordance with their thermal rating has been ably covered in previous papers. It is our intent to discuss this problem from a practical viewpoint so that we may see what has been done and what can be done to realize some of the savings to be attained by thermal loading.

Review of Load Supervising Methods

The fundamental requirement of any system of testing is that it shall indicate with a reasonable degree of accuracy the absolute load on the transformer, whether it is heavily overloaded or loaded to a fraction of its nameplate rating.

Systems of checking and recording employed by various companies differ widely as to details of procedure, but there are only three fundamental methods of obtaining basic load data.

1. Load Estimate Method

This classification embraces the systems that depend upon a count of services or tabulation of customer consumption and the correlation of such information with established test data covering demands and diversities of various classes of load.

2. Periodic Test Method

Under this heading are grouped the systems that employ routine load checks with indicating or recording instruments of all types.

3. Thermal Load Indicator Method

This group includes methods that employ permanently installed load indicators designed primarily to give an indication when the load approaches the thermal limit of the transformer.

Each of these general methods possesses certain advantages but at the same time has very definite limitations for certain types of load. It follows then that a procedure of transformer testing to fulfill the diverse requirements of a large system must make use of two and perhaps all three of these methods.

1. Load Estimate Method

It is probable that every large company has compiled load and diversity data to assist its field engineers in determining the proper size of transformer to feed a given group.

Our experience has been that such data are of great value for two specific purposes; to establish the size of transformer necessary for a new area or to determine the approximate load on a transformer in the absence of actual test data. It must be remembered that a sufficient number of classifications must be established to cover the entire range of demands. Because of difference in climate, rate structure and the effect of gas competition on cooking, water heating and refrigeration, each company must develop its own load data. Furthermore, it has been found that frequent revisions are necessary to keep pace with changing load characteristics. Figures 1-5 illustrate some of the test material that our company has taken over the past few years.

A highly developed system of load supervision based on demand estimates is employed by the Puget Sound Power and Light Company. In that territory they have a large number of ranges and water heaters in addition to the usual appliance load. The effect of this high-demand load on the tables of transformer capacity has been taken into account in a most ingenious fashion as illustrated in Fig. 6, which is one of a series of instruction sheets covering the loading of distribution transformers serving residences and small commercial customers. As part of the system, a survey of the monthly kwhr consumption of the customers connected to each transformer is made and recorded on the detail and summary forms shown in Fig. 7. Commercial customers are reduced to residential equivalent at the rate of one per 100 kwhr of monthly consumption, flat rate water heaters at one per 500 watts of rating, and off-peak water heaters and ranges by use of tables shown in Fig. 6.

A more detailed account of this method can be found in an article entitled "Choosing Transformer Sizes for Distribution Circuits" by R. Rader, published in the *Electrical World* of Jan. 16, 1937.

2. Periodic Load Test Method

Of all systems of supervising transformer loading, the periodic load test is probably the most widely employed. While the period over which peak load exists may be decidedly limited, the test data for residential areas can readily be converted to terms of electrical or thermal peak by use of tables or curves of seasonal load variation and transformer thermal characteristics. This is a highly important factor from a practical standpoint since it means that the period for testing residential transformers may be extended over several months. This cannot be so readily applied to commercial or power transformers as there is much less uniformity in their load characteristics.

In spite of its limitations the spot check with a simple split-core transformer and indicating ammeter has much to recommend it. It is comparatively inexpensive, our company having made tests at a cost of from .30 to .50 a transformer. This method has the further advantage of providing a check on load balance.

As stated previously, periodic load checks do not have to be made during the peak month of the year. From data taken by means of recording ammeters on transformers serving large groups of residential customers we have established curves showing weekly variation of peak demand throughout the year. Such a curve is shown in Fig. 8. Two facts of importance are to be observed; first, the evening peak during the seven standard time months never falls below 85 per cent of the average December peak, and the holiday peak exceeds the December average by about 25 per cent. In order to determine the hours when tests could be made and still be within reasonable accuracy, the curve in Fig. 9 was developed. You will note that between the times shown in the hatched area the reading was at least 90 per cent of the peak. When this system was first

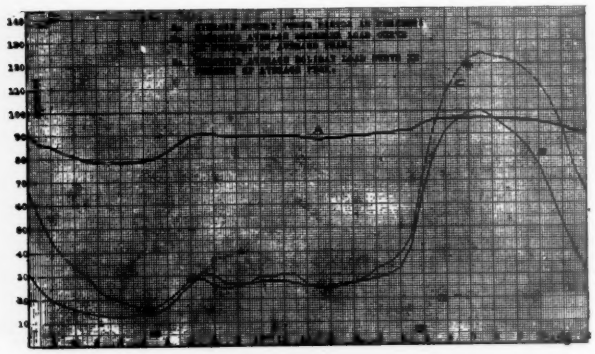


Fig. 1—Power Factor of Residential Lighting Loads—Residential Lighting Load Curves—1929.

A. Average Hourly Power Factor in Per Cent.
B. Weighted Average December Load Curve in Per Cent of Average Peak.
C. Weighted Average Holiday Load Curve in Per Cent of Average Peak.

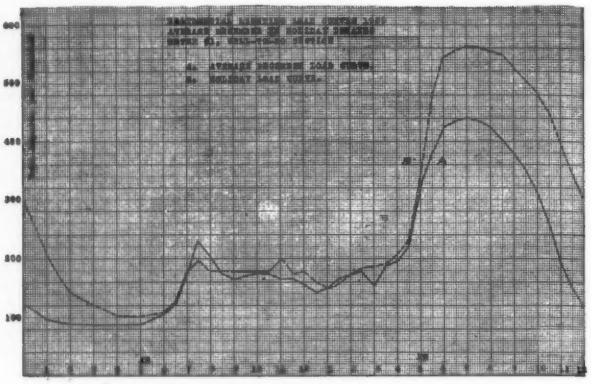


Fig. 2—Average December vs. Holiday Demands, Meter No. 1, Well-to-Do Section—Residential Lighting Load Curves—1929.

A. Average December Load Curve.
B. Holiday Load Curve.

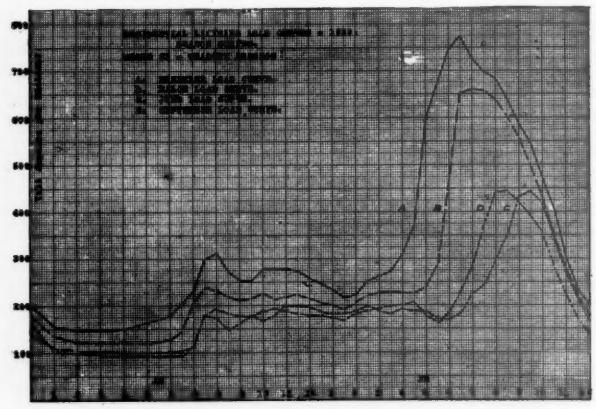


Fig. 3—Season Curves, Meter No. 3, Wealthy Section—Residential Lighting Load Curves—1929.

A. December Load Curve.
B. March Load Curve.
C. June Load Curve.
D. September Load Curve.

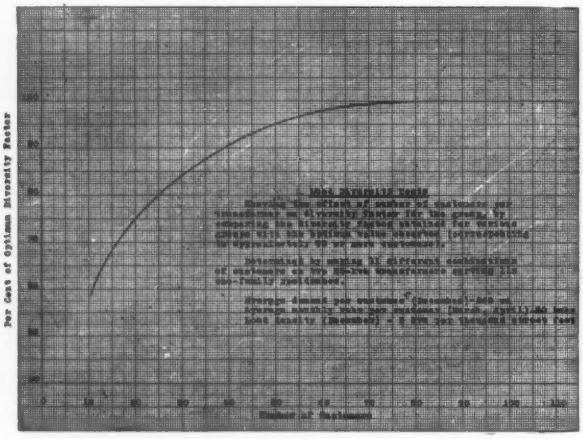


Fig. 4—Load Diversity Tests.

Showing the effect of number of customers per transformer on diversity factor for the group, by comparing the diversity factor obtained for various groups with the optimum value observed (corresponding to approximately 80 or more customers).

Determined by making 11 different combinations of customers on two 25-kva transformers serving 113 one-family residences.

Average demand per customer (December)—260 va.

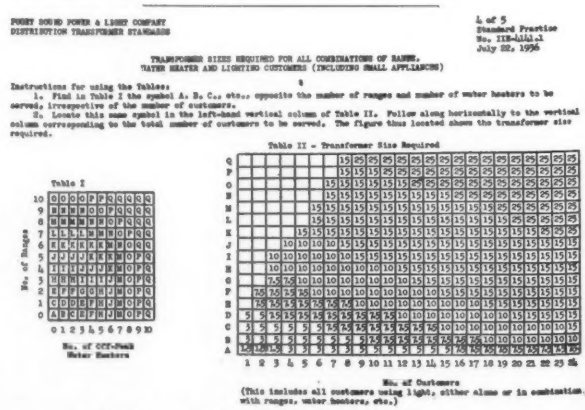
Average monthly kwhr per customer (March, April)—50 kwhr.

Load density (December)—5 kva per thousand street feet.

COMPARISON OF RESIDENTIAL LOAD CHARACTERISTICS
Month of December, 1929 and 1934

	Baker Street	Park Place	Garrison Street
I Unit Consumption (kwhr per customer)			
1929	117	51	36
1934	149	62	38
Increase	27.4%	21.6%	5.6%
II Unit Demand (volt-amperes per customer)			
1929	438	207	175
1934	497	247	195
Increase	13.5%	19.3%	11.4%
III Group Load Factor (average week-day)			
1929	46%	41%	34%
1934	58%	45%	44%

Fig. 5—Comparison of Residential Load Characteristics.



PUGET SOUND POWER & LIGHT COMPANY
DISTRIBUTION TRANSFORMER STANDARDS

4 of 5
Standard Practice
No. IIB-1(b).1
July 22, 1936

TRANSFORMER SIZES REQUIRED FOR ALL COMBINATIONS OF RANGE, WATER HEATER AND LIGHTING CUSTOMERS (INCLUDING SMALL APPLIANCES)

Instructions for using the Tables:
1. Find in Table I the symbol A, B, C, etc., opposite the number of ranges and number of water heaters to be served, irrespective of the number of customers.
2. Locate this same symbol in the left-hand vertical column of Table II. Follow along horizontally to the vertical column corresponding to the total number of customers to be served. The figure thus located shows the transformer size required.

Table I

No. of Ranges \ No. of Off-Peak Water Heaters	0	1	2	3	4	5	6	7	8	9	10
10	O	O	O	O	P	P	Q	Q	Q	Q	Q
9	N	N	N	O	O	P	Q	Q	Q	Q	Q
8	M	M	M	N	O	P	Q	Q	Q	Q	Q
7	L	L	L	L	N	M	O	P	Q	Q	Q
6	K	K	K	K	K	M	M	O	Q	Q	Q
5	J	J	J	J	K	K	M	O	P	Q	Q
4	I	I	I	I	J	J	K	M	O	P	Q
3	H	H	H	H	I	I	J	K	M	O	P
2	G	F	F	G	G	I	I	J	M	O	P
1	C	C	D	F	F	H	H	J	M	O	P
0	A	B	C	E	F	H	H	J	M	O	P

Table II - Transformer Size Required

No. of Ranges \ No. of Customers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	22	25
Q									15	25	25	25	25	25	25	25	25	25	25	25	25	25	25
P									15	15	25	25	25	25	25	25	25	25	25	25	25	25	25
O								15	15	15	15	15	15	25	25	25	25	25	25	25	25	25	25
N								15	15	15	15	15	15	15	15	25	25	25	25	25	25	25	25
M							15	15	15	15	15	15	15	15	15	15	15	15	25	25	25	25	25
L							15	15	15	15	15	15	15	15	15	15	15	15	15	25	25	25	25
K						15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	25	25	25
J					10	10	10	10	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
I				10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	15	15	15	15
H				10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	15	15
G			7.5	7.5	10	10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15
F		7.5	7.5	7.5	10	10	10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15
E		7.5	7.5	7.5	7.5	7.5	10	10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15
D	5	5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	10	10	10	10	10	10	10	10	15	15	15	15	15
C	3	5	5	5	5	5	7.5	7.5	7.5	7.5	7.5	7.5	10	10	10	10	10	10	10	10	10	10	15
B	3	3	3	3	3	3	3	3	3	7.5	7.5	7.5	7.5	7.5	7.5	7.5	10	10	10	10	10	10	10
A	1.5	1.5	1.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

No. of Customers

(This includes all customers using light, either alone or in combination with ranges, water heaters, etc.)

Fig. 6—Tables of Transformer Sizes Required for All Combinations of Range, Water Heater and Lighting Customers.

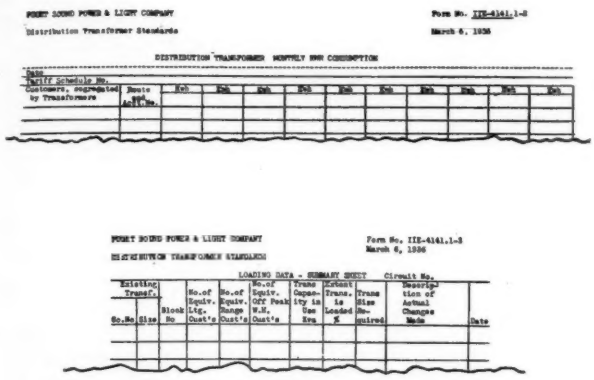


Fig. 7—Distribution Transformer Standards Records.

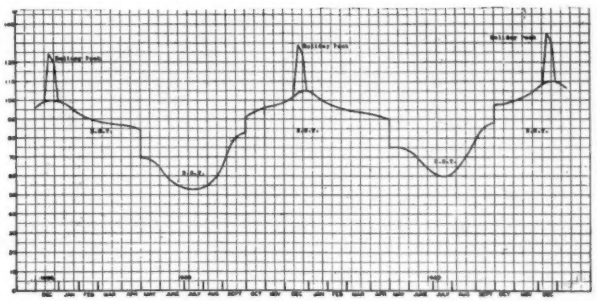


Fig. 8—Weekly Variation in Average Peak Demand Per Customer.

Note: Points represent average of six week-days, expressed in per cent of December, 1928 average peak.

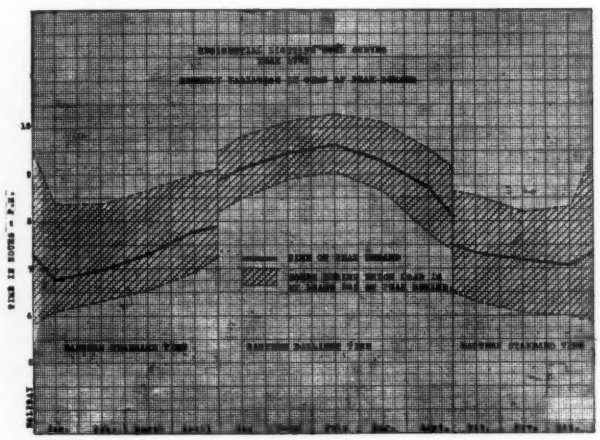


Fig. 9—Monthly Variation in Time of Peak Demand—Residential Lighting Load Curves, 1929.

Heavy Line = Time of Peak Demand. Cross Hatching = Hours during which load is at least 90% of Peak Demand.

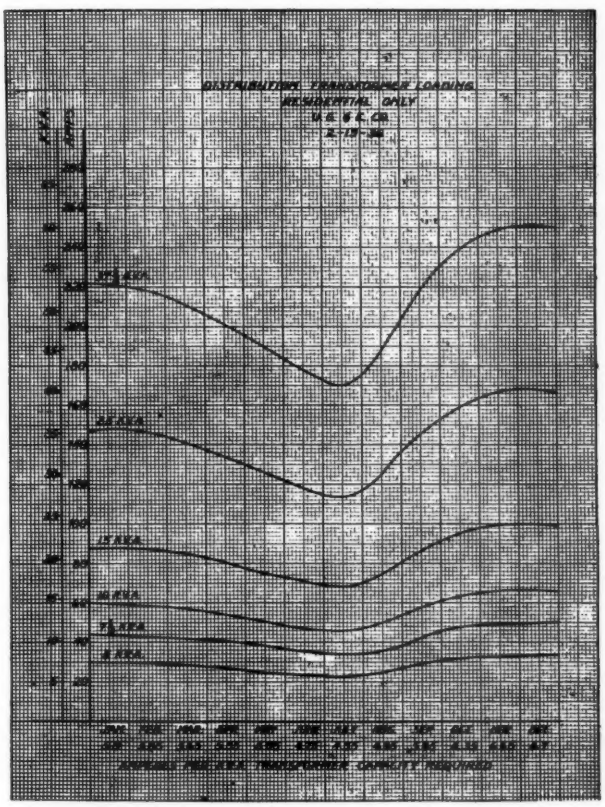


Fig. 10—Distribution Transformer Loading—Residential.

adopted it was our intention to load the transformers up to 100 per cent of their nameplate rating for the average December peak, thus automatically allowing a holiday peak of 125 per cent or more. We have since thought this to be too conservative and are now allowing 125 per cent for the average December peak with 150 per cent for the holiday peak.

The Union Gas and Electric Company of Cincinnati has in operation an essentially similar system. This system is especially interesting in that the basic load limit is determined from a calculated coil and oil rise above average ambient. The maximum load thus established is equivalent to 160 per cent of nameplate rating. The maximum allowable current values for standard transformer sizes for every month in the year are shown by curves in Fig. 10.

In general, there are two types of load records that are used in lieu of instantaneous reading where the latter are considered unreliable. First, there is the recording ammeter that draws the entire load cycle on a circular or strip chart. This method of testing possesses obvious advantages in that it not only indicates the maximum load but also produces a record of the individual characteristics of the load of each transformer. An ingenious variation of this method has been worked out by the Philadelphia Electric Company in which an integrating ampere-squared-hour meter with a 15 minute demand attachment is used. This meter is operated over the eight hours of heavy load and the resultant curve of the eight hour copper loss factor versus computed hot spot rise factor shows a close correlation over a wide range of load characteristics.

3. Thermal Load Indicator Method

The use of thermometers to indicate the oil temperature of transformers goes back over many years. It has the dis-

advantage however that its absolute reading must be adjusted for the effect of ambient temperature. In other words, it is not a direct reading device.

About 1928 the General Electric Company brought out an instrument known as the Thermotel which automatically compensates for the effect of ambient temperature and thus furnishes a direct indication of the percentage of thermal capacity at which the transformer is being operated. These first instruments were fairly accurate at 100 per cent loading but left much to be desired in the matter of indications of load at less than 100 per cent. The General Electric Company has recently redesigned their Thermotels and the new instrument promises to be much more accurate over wider ranges than the old ones.

It is obvious that any load indicator that is actuated by the change in oil temperature has an inherent time lag and therefore will not indicate dangerous copper temperatures produced by heavy loads of short duration. In order to provide protection against damage from short overloads as well as those of normal duration, the Westinghouse Electric and Manufacturing Company has developed the type CSP transformer that incorporates a built-in, thermally-operated, secondary breaker. This breaker will open when the copper temperatures of the winding rises to a dangerous point (about 125 deg. C) regardless of whether that temperature has been produced by a heavy overload of short duration, or by a moderate but sustained overload. An indicating light has been provided to show when winding temperature has reached 100 deg. C.

Regardless of the difference in principle of operation and details of construction, both of these load indicators possess an outstanding advantage in that they automatically evaluate the factors of ambient temperature and load duration.

4. Approximate Costs of Load Supervising Methods

It is extremely difficult to obtain accurate figures on unit costs of the various load checking methods discussed above because of difference in routine of procedure, number and type of men employed, and similar variables.

The following summary therefore is given merely to indicate the approximate relative costs. They represent a fair estimate of unit costs as applied to the Public Service of New Jersey system and it is realized that they may not apply elsewhere.

Method	Approx. Annual Cost Per Unit Tested
Load Estimate	Indeterminate
Periodic Load Test	
Spot Check, Indicating Meter	.40
Spot Check, 30 Minute Meter	1.20
Recording Meter	2.40
Thermal Load Indicator	
Thermometer	1.50
Thermotel	2.00
Thermal Breaker	2.00

Practical Application

Having discussed the principles employed under the three general classifications of load supervising methods, it is necessary to examine their relative costs and to analyze the specific requirements of a particular transformer plant in order to make an intelligent choice of method for that plant. Obviously, if our sole objective is the realization of the ultimate in transformer loadings, we should adopt one of the thermal load indicators, but we are also concerned with cost and quality of service. Our problem is to attain that degree of loading that will result in the lowest overall cost commensurate with satisfactory service. From a service standpoint we must recognize the limitations imposed by voltage regulation at the higher loadings as well as the necessity of avoiding interruptions due to transformer failures.

To state that any one system best fulfills the requirements of all distribution plants would be absurd, for in all probability a combination of the methods outlined above will result in the best overall economy.

For the purposes of illustration, we will take the distribution plant of the Public Service Electric and Gas Company.

1. Survey of Transformer Plant of Public Service Electric and Gas Company.

This company has in operation approximately 41,000 distribution transformers having a total capacity of 1,000,000 kva. For load checking purposes these transformers may be classified according to predominant types of load served, as follows:

Classification	No. Units	Total Capacity kva	Average Capacity kva
Overhead			
Residential	20,000	300,000	15
Commercial	4,000	90,000	22
Power	14,900	440,000	30
	38,900	830,000	
Underground			
Residential	400	8,000	20
Commercial	1,500	150,000	100
Power	200	12,000	60
	2,100	170,000	

For the purposes of this discussion we have classified these transformers into definite customer groups although actually there are many units that serve two and possibly all three of these classes. In this table there are included many transformer units used to supply power to individual customers. Many of these customers have measured demand which records are adequate for proper supervision of loading. There are about 1200 transformers in this group. Furthermore, about 11,000 transformers are used in polyphase banks which, for testing purposes, are equivalent to about 4,200 units. Because of lower loading under normal operation a separate classification of 900 units in network service is desirable. These considerations reduce the number of test locations to approximately 33,000.

2. Before adopting any methods of supervision, we must consider the practical limits of transformer loading for each service classification.

(a) Residential.

The loading on the majority of transformers for this class of service is limited by regulation. Our transformer secondary combinations are designed for a total drop of 4.5 per cent assuming reasonable uniformity of load distribution and balance on the secondary. Our studies indicate that best economy is obtained in the overhead plant with combinations of 15 or 25 kva transformers and No. 4 secondaries up to a density of 20 kva per thousand feet and No. 1 wire for greater densities. With this design the transformer loading is limited by the voltage requirement to 150 per cent of nameplate rating except in cases where the load is concentrated at the transformer or the transformer is located ahead of the feeder voltage center.

(b) Commercial.

Because of the greater load density in commercial areas the voltage requirement is more readily met and the thermal limit may be taken as the criterion for loading. For overhead units, this may amount to 175 per cent of nameplate rating at low ambients.

(c) Power.

Regulation is seldom a factor in the loading of power transformers because of the more liberal voltage tolerance (our standard voltage being 120-240) and because the secondary runs are usually short. The thermal limit is therefore our objective in loading power banks. This value may range from 100 per cent to 200 per cent.

3. Selection of Supervising Method.

(a) Load Estimate.

As outlined previously, characteristic

curves, customer demands and similar data are made available to our field men for their guidance for determining transformer sizes for new installations and rough load checks.

(b) Periodic Load Test.

For the 20,000 overhead units serving residential customers the split core test employing the simple indicating ammeter offers the best means of attaining the maximum loading. It is the cheapest of all methods, it affords a check on balance, and with proper supervision yields reliable results over an extended testing period. The split core ammeter may be used where commercial loads conform to known characteristics or for preliminary tests on power transformers.

(c) Thermal Load Indicator.

Some form of thermal load indicator seems to be the ideal means of attaining the ultimate degree of loading on all underground units, on the majority of power transformers, and overhead commercial units and occasionally on overhead residential units where voltage regulation is not the limitation.

The Thermotel is decidedly useful as a portable instrument to determine if a transformer should be changed due to overload.

Results and Conclusions

The preceding outline represents the ideal toward which we are working. At present we are using split core tests extensively on a routine that provides for testing lighting transformers at least once in four years with more frequent tests on those approaching full load. We have in regular service approximately 4,000 Thermotels and 500 Thermometers which are read at least once a year.

As an example of what has been accomplished in one of our operating divisions over the last four years, we give you the following figures:

1932 Transformer Capacity 74,782 kva,
sum of circuit peaks 41,175 kva
1935 Transformer Capacity 70,415 kva,
sum of circuit peaks 47,224 kva

This shows a saving of 4,300 kva in transformer capacity in the face of a 5,000 kva increase in circuit loads. Assuming a value of $8.00 per kva, this represents a saving of more than $30,000 in new transformer investment.

In conclusion, let it be understood that we do not recommend any particular method of load supervision as being vastly superior to any other. The emphasis should be upon the intelligent and persistent application of whatever system is best suited to local requirements, rather than upon the details of the system itself.

SALES—ELECTRIC REFRIGERATORS

(Household Models Only)

MONTH OF JUNE AND FIRST SIX MONTHS OF 1937-1936

	Month of June 1937	Month of June 1936	Month of May 1937	First Six Months 1937	First Six Months 1936
Total United States	267,770	237,371	333,061	1,705,750	1,441,559
Maine	1,059	1,321	1,433	6,391	6,471
New Hampshire	999	754	914	5,038	5,669
Vermont	405	679	1,004	4,380	3,695
Massachusetts	7,851	8,725	11,367	67,200	57,125
Rhode Island	983	931	1,206	8,933	7,605
Connecticut	4,208	3,465	5,368	31,207	23,780
Total New England	15,505	15,875	21,292	123,149	104,345
New York	31,758	24,955	35,901	181,896	151,563
New Jersey	11,538	8,954	10,613	66,645	61,576
Pennsylvania	29,285	22,099	31,707	167,051	131,966
Total Middle Atlantic	72,581	56,008	78,221	415,592	345,105
Ohio	21,180	17,208	25,753	126,517	94,319
Indiana	8,219	6,531	9,806	49,376	41,172
Illinois	21,815	16,663	29,487	137,392	108,594
Michigan	15,264	11,413	19,294	90,037	70,708
Wisconsin	5,962	3,542	5,279	36,391	25,961
Total East North Central	72,440	55,357	89,619	439,713	340,754
Minnesota	3,512	3,195	6,429	30,351	19,896
Iowa	3,833	3,411	4,393	27,609	23,131
Missouri	7,369	7,155	10,057	51,585	46,509
North Dakota	310	360	507	3,089	2,929
South Dakota	301	784	621	3,740	4,258
Nebraska	1,661	2,212	1,931	12,962	13,854
Kansas	2,403	3,119	4,099	20,602	18,395
Total West North Central	19,389	20,236	28,037	149,938	128,972
Delaware	766	398	907	3,670	2,706
Maryland	3,418	2,068	4,447	20,402	16,936
District of Columbia	2,162	2,215	2,450	12,403	12,428
Virginia	4,539	3,354	5,606	27,273	23,278
West Virginia	4,210	3,237	4,194	22,324	20,286
North Carolina	5,888	5,075	9,161	39,491	30,243
South Carolina	2,888	1,995	3,823	18,569	14,088
Georgia	5,134	5,771	6,101	31,890	26,231
Florida	2,894	2,491	2,763	17,754	14,798
Total South Atlantic	31,899	26,604	39,452	193,776	160,994
Kentucky	4,778	3,733	4,965	23,801	20,028
Tennessee	3,858	4,477	6,450	29,055	24,158
Alabama	3,360	2,697	4,047	19,516	16,943
Mississippi	1,127	1,334	2,172	9,477	8,223
Total East South Central	13,123	12,241	17,634	81,849	69,352
Arkansas	1,342	1,660	2,170	10,532	9,800
Louisiana	2,376	2,184	3,629	17,057	15,169
Oklahoma	2,505	1,691	2,984	17,737	16,083
Texas	8,291	11,137	14,032	67,037	59,903
Total West South Central	14,514	16,672	22,815	112,363	100,955
Montana	960	1,453	1,310	6,607	6,638
Idaho	1,125	1,323	996	6,841	7,358
Wyoming	306	448	475	2,420	2,074
Colorado	1,503	2,184	1,789	11,380	11,145
New Mexico	408	595	930	3,647	3,199
Arizona	583	719	1,055	5,815	5,359
Utah	1,388	1,726	1,444	8,751	9,286
Nevada	287	355	766	2,178	1,823
Total Mountain	6,560	8,803	8,765	47,639	46,882
Washington	4,258	4,838	3,347	23,648	23,941
Oregon	2,261	2,530	2,065	12,720	15,929
California	15,240	18,207	21,814	105,363	104,330
Total Pacific	21,759	25,575	27,226	141,731	144,200

Figures based on report by the NEMA on Net Sales to Dealers and Jobbers.

Progress of Better Light-Better Sight Reported at Annual Meeting of Bureau

THE extraordinary progress of the Better Light-Better Sight movement during the past year was outlined in the report of the Chairman, M. E. Skinner, and Secretary Manager, G. R. Trumbull, to the annual meeting of the Better Light-Better Sight Bureau in New York on July 15.

"If any one thing was to be selected as the outstanding feature during the year," said the report, "it is the conclusive evidence that the Better Light-Better Sight movement—its objectives and benefits—have definitely broken through the public consciousness and caused millions to do something for better seeing conditions. It would be difficult to name other equivalent national programs of an educational nature as broad in scope as this one that has had as quick response and wide acceptance by the great mass of people.

Notable instances of industry cooperation during the past year was the Better Sight Week promoted last fall in over seventy cities in which the local optical and utility interests joined hands to feature eye care and proper lighting for better seeing.

"Save Your Vision Week" held last February, an annual affair of many years standing, and promoted by the American Optometric Association and Better Vision Institute, was actively supported in over eighty cities by local Utilities, Sight Saving Councils and Better Sight Bureaus.

Outstanding in importance to the Better Sight movement was the annual conference of the National Society for the Prevention of Blindness held last fall in Columbus, Ohio. On the program of this great humanitarian organization devoted entirely to eye health and protection of eyesight was included a large number of addresses and papers by nationally known educators and medical authorities in which adequate lighting was continually referred to as so necessary to maintain good eyesight.

Another development, highly important and encouraging, was the inauguration of the National Lighting Conference, as a part of the annual convention of the American Institute of Decorators, held last June in New York.

Several hundred of the country's leading decorators heard the presiding officer, Mr. Stanley McCandless, Professor of Lighting at Yale University, advocate the importance of lighting in any job of decorating well done.

Bureau headquarters recorded editorials and articles published in 74 national consumer and trade magazines last year and in some cases several articles appeared at different times in specific publications.

An extensive cross section check of newspapers nationally indicated that over fifteen hundred large and small newspapers carried editorials and news stories pertaining to Better Light-Better Sight during the year.

From careful checking it is estimated that over 1,200,000 column inches of space was devoted to news articles and editorials.

Newspaper advertising, carried on chiefly by utilities and sight-saving groups, total over 6,000,000 column inches to a circulation of over 45,000,000.

Over 200 pages of trade paper advertising were run principally in electrical, paint and optical publications including some phase on Better Light-Better Sight.

Over 250 radio stations were broadcast messages consistently throughout the year to many millions of listeners.

The progress and activities of local Sight Saving Councils and similarly organized groups continued among the outstanding accomplishments of the past year. At present there are 85 of these local groups functioning and most of them set up on a firm, permanent basis assuring a continuing local program.

From the electrical viewpoint probably the most tangible evidence of the public's willingness to do something about improving seeing conditions is in the yearly sales of the scientifically designed and certified I.E.S. lamps. Last year 1,100,000 of these lamps bearing the certification tag were sold and it is conservatively estimated that an equal number were sold without tags. The climax of the year's sales occurred during the month of October with the greatest concentration of sales effort, advertising and promotion in lamp history. Over 250 utilities organized special campaigns, beginning October 1, a great many of which carried on through the balance of the year and into the early months of 1937. In nearly every case utilities made a special effort to encourage all local lamp retailers to join in the campaign. Reliable sources estimate that over 5,000 lamp dealers entered into the activity with varying results. In some localities the combined dealer sales exceeded those of the highly concentrated efforts of the utilities.

Efforts to improve seeing conditions in schools have advanced rapidly during the year. Better Light-Better Sight advocates have been quick to realize the possibilities in the 275,000 schools and colleges of the country with an enrollment of approximately 32,000,000 school children and students.

In the commercial and industrial fields the theme of the Better Light-Better Sight program has started a new trend of thought in respect to more efficient workers and better satisfied customers. Store owners and plant operators have become more receptive to the new approach of better seeing conditions as a definite factor for more and better business. Every city and almost every town of the country has many examples as a result of efforts during the year, of lighting standards having been raised from one to five times the former conditions.

Progress in improving seeing conditions in offices has been particularly noteworthy during the year. Demands of office workers and appreciation of increased efficiency by employers has largely influenced the installation of better lighting. Many building owners and managers have been quick to sense the sales possibilities for space by installing and featuring better lighting as a sales argument.

Among the many activities which the bureau will endeavor to stimulate during the coming years will be:

1. Increased cooperation with and by the medical and optometrical professions.
2. Better schoolroom lighting for protection of young eyes.
3. Intensified efforts for the sale of proper seeing equipment.
4. Continued promotion of better seeing in the home.
5. Increased concentration in the commercial, industrial and office fields.
6. Adequate lighting for greater safety on highways and in the home.
7. Development of more local cooperative programs among those directly concerned in promoting eyesight conservation.

Ventilation of Manholes

Effect of the Size of the Manhole on Natural Ventilation

By G. W. Jones[1], W. E. Miller[2], John Campbell[3] and W. P. Yant[4]

(Reprinted from Bureau of Mines Report of Investigations 3343)

IN a previous report of the Bureau of Mines[5] results were given that showed the amount of natural ventilation in a manhole having a capacity of 74.1 cubic feet when the number of ventilation openings in the cover was varied from no openings to a maximum of 48.

The results showed that the ventilation (air changes per day) in the manhole was proportional to the area of the openings in the cover, and also that the number or area of the openings was the factor that chiefly affected the ventilation.

Experiments in Larger Manholes

The manholes used by most utilities are larger in capacity than the one in which the above tests were made. To determine the effect of the size of the manhole on the natural ventilation when such ventilation is obtained by installing ventilation openings in the cover, two larger manholes were constructed, and ventilation tests were carried out in them. The dimensions and capacities are given in Table I.

Not only did the capacity of the three manholes vary, but their shape and design were different, also. Manholes A and C simulated rectangular shafts and were considerably greater in depth than their cross-sectional dimensions, while manhole B, though not so deep as the others, was greater in cross-section. The latter was also eight-sided and was provided with two ventilation ducts, as shown in Figure 1. In the tests reviewed in this report the ducts were sealed and did not function.

Test Procedure

The method of determining the amount of ventilation in the manholes followed that described in a previous re-

TABLE I—DIMENSIONS AND CAPACITIES OF MANHOLES TESTED

Manhole	A	B	C
Capacity, cu. ft.	74.1	166.7	308.0
Horizontal dimensions, inches	36 by 36	83.5 by 60	74.5 by 68.5
Vertical height from the bottom of manhole to cover, inches	96	76	111
Details of construction	See Fig. 1, R. I. 3307	Fig. 1	Fig. 2

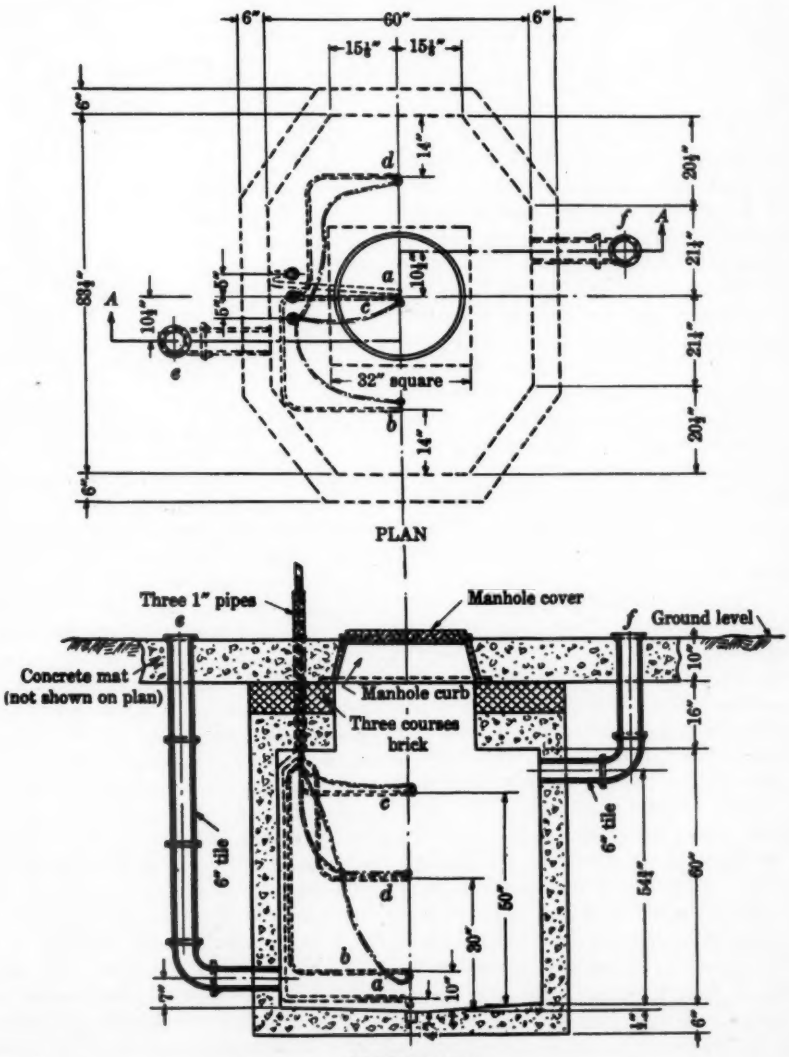


Figure 1—Experimental Manhole.

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[2] Research assistant, cooperative employee.

[3] Superintendent, Special Service Department, Edison Electric Illuminating Co. of Boston, Boston, Mass.

[4] Supervising engineer, U. S. Bureau of Mines, Pittsburgh Experiment Station, Pittsburgh, Pa.

[5] Jones, G. W., Miller, W. E., Campbell, John, and Yants, W. P., Ventilation of manholes. 1—Effect of Holes in the Covers on Natural Ventilation: Rept. of Investigations 3307, Bureau of Mines, June, 1936, 6 pp.

port[6] and was developed originally and used by the Bureau of Mines to determine the air changes in rooms contaminated by combustion products from space heaters burning natural gas. The method may be described briefly as follows: If a gas is fed into a manhole at a known constant rate and in such a manner that a homogeneous atmosphere of the gas in the air in the manhole is produced, the concentration of the added gas reaches a maximum when the amount of gas escaping from the manhole due to ventilation equals the amount fed into the manhole. When this condition is reached, formula $R = 100 Q/CV$ is used to determine the number of air changes that take place in the manhole per day. In the above formula, R = the number of air changes per day, Q = the cubic feet of gas fed into the manhole per day, C = the average maximum percentage of gas in the manhole, and V = the volume of the manhole in cubic feet.

Previous tests have shown that when a gas lighter than air is used, it is necessary to admit the gas into the manhole at the bottom to obtain uniform distribution of the gas added to the manhole atmosphere, while for gases heavier than air the gas should be admitted at the top.

Any gas may be used to determine the ventilation rate or air changes that take place in a manhole per day, provided its concentration in the manhole can be determined to the proper degree of accuracy and the gas is admitted to the manhole at the proper place. Natural gas as supplied at the Pittsburgh Experiment Station was found suitable and was used in all tests made in manholes A and B.

Manhole C was adjacent to a large storage building, where the presence of combustible gas in the manhole in explosive proportions would create a dangerous condition and great damage might result should the mixtures in the manhole become ignited. It was decided, therefore, to use an incombustible gas. Carbon dioxide was tried in this manhole and was found suitable, provided the gas was admitted into the manhole space at the top and at four or more different points. When this gas was admitted at a single point in the center just below the cover, the carbon dioxide, being about 1.5 times as heavy as the air in the manhole, tended to descend the central part of the manhole and give a non-uniform mixture. By admitting the carbon dioxide through a manifold at four points, as shown in Figure 2, and having the inlets near the outer walls of the manhole, a uniform distribution was obtained through the manhole space.

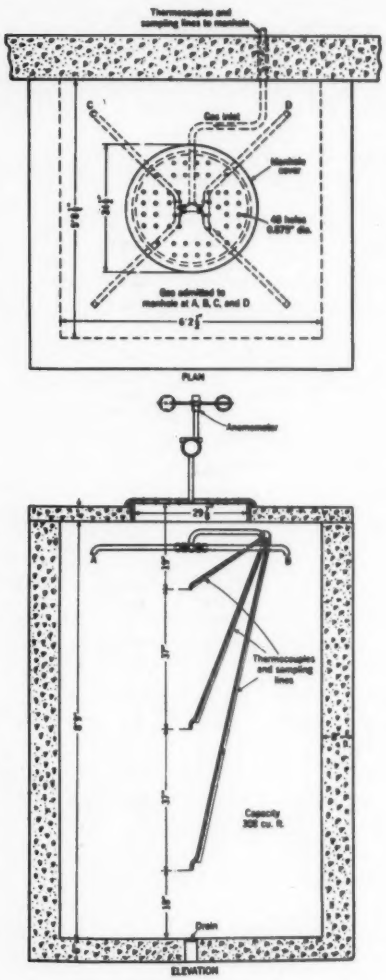

Figure 2—Experimental Manhole C.

An additional reason for testing and using carbon dioxide is that field tests are contemplated, and it will not be permissible to use a combustible gas because of the dangers of creating explosive hazards in the manholes and duct lines.

Before each test was begun, the cover was removed and the manhole purged with fresh air for several hours by means of a mechanical blower. The cover was replaced, and all ventilation openings except the number chosen for test were closed with rubber stoppers. The flow of gas into the manhole was started and adjusted to the desired rate, as indicated by a calibrated flowmeter. The actual quantities of gas were measured by a calibrated wet meter. Usually the tests were begun in the evening and allowed to run all night, so that the desired rate could be checked accurately and the maximum concentration of gas in the manhole reached during the night. The time required to reach this maximum concentration varied with the amount of ventilation and usually required one to eight hours.

Samples of the atmosphere were taken at the top, middle, and bottom of the manhole at four- to eight-hour intervals, depending on the duration of the test. When tests lasted more than two days, the atmosphere was sampled three times a day. Coincident with the taking of the samples, measurements and records were made of the temperature, both inside the manhole and 2½ feet above the manhole cover, the gas rate per hour, barometric pressure, average wind velocity, relative humidity, weather conditions, and rainfall.

In the tests in which carbon dioxide was used, 430-cubic-foot cylinders were used. The compressed gas was first passed through a pressure regulator to reduce the pressure to the desired value; then the gas was passed through an overflow device, where any gas in excess of that required to give the desired rate, as indicated on the calibrated flowmeter, was allowed to go to waste; then through the calibrated wet meter; and thence through a copper tube into the manhole.

In the tests in which natural gas was used, a similar procedure was followed, with the exception that the natural gas from the mains did not pass through a pressure regulator because the initial low pressures exerted by the gas did not make such a device necessary.

Results of Ventilation Tests in Large Manholes

The results obtained in manholes B and C are given in Table II. The capacity of the manholes in cubic feet; the gas used in the tests; the number and size of the ventilation openings; the area of the openings, in square inches; the area of the openings, in square inches per 100 cubic feet of manhole space; the average amount of gas fed into the manhole per day, in cubic feet; the average maximum concentration of the gas in the manhole at the top, middle, and bottom position over the test period; the average concentration of gas for the whole test period; the duration of the test, in days; the average wind velocity; and the ventilation in terms of air changes per day, are given.

The results of the tests in the small manhole, *a*, which had a capacity of 74.1

[6] Jones, G. ., Miller, W. E., Campbell, John, and Yant, W. P., Work cited (footnote 5).

cubic feet, have been given in a previous report[5], and the test data need not be repeated. The summarized results obtained in this manhole, which show the relation between the area of ventilation openings, in square inches per 100 cubic feet of manhole space, versus the number of air changes per day, are shown graphically in Figure 3 along with the results obtained in manholes B and C.

Effect of Rate at Which Is Admitted on Ventilation

The formula $R = 100\ Q/CV$, used to calculate the number of air changes that take place in the manhole per day, should not be influenced by the amount of gas fed into the manhole per day. The greater the amount of gas fed into the manhole per day, the higher should be the concentration of the gas in the manhole when the maximum concentration is reached. To determine whether the rate at which the gas was fed into the manhole had any appreciable effect on the ventilation, a number of tests were made at different gas rates, keeping the area of ventilation openings per 100 cubic feet of manhole space constant. These results are given in Table II. It is seen that there is considerable variation in the air changes obtained at different rates of gas admission, but no definite conclusion can be drawn, because, although in most cases increased gas admission decreased the calculated number of air changes, in other tests there was an increase.

Effect of Wind Velocity and Temperatures on Ventilation

Tests that were made in the different manholes have shown that the wind velocity or speed at which air passes over the manhole cover has a marked effect on the ventilation rate. Also, the time of year must be considered, because when the manhole temperatures are much higher than the outside air temperature, other conditions being constant, the ventilation rates increase.

The tests enumerated in Table II and shown graphically in Figure 3 cover all seasons of the year and varying wind velocities. They were purposely carried out under these conditions so that results closely duplicating conditions found in the streets of a typical American city would be obtained.

Effect of Size of Manhole on Ventilation

When the number of air changes in the manhole per day are plotted against the area of ventilation openings, in square inches per 100 cubic feet of man-

TABLE II—MANHOLE VENTILATION TESTS. AIR CHANGES PER DAY VERSUS CHANGE IN AREA OF VENTILATION OPENINGS AND EFFECT OF SIZE OF MANHOLE

Test No.	Manhole	Capacity, cu. ft.	Gas used in tests	No. of ventilation openings in manhole cover	Area of openings, sq. in.	Area of openings, sq. in. per 100 cu. ft. manhole space	Average amt. of gas fed into manhole per day, cu. ft.
3-a	B	166.7	Natural gas	48[1]	21.66	13.04	14.59
17-a	B	166.7	Natural gas	48[1]	21.66	13.04	71.43
15-a	B	166.7	Natural gas	48[1]	21.66	13.04	72.40
4-a	B	166.7	Natural gas	36[1]	16.36	9.82	14.58
5-a	B	166.7	Natural gas	36[1]	16.36	9.82	27.07
38-a	B	166.7	Natural gas	36[1]	16.36	9.82	49.50
2-a	B	166.7	Natural gas	24[1]	11.07	6.62	14.57
41-a	B	166.7	Natural gas	24[1]	11.07	6.62	48.20
22-a	B	166.7	Natural gas	24[1]	11.07	6.62	68.08
25-a	B	166.7	Natural gas	12[1]	5.76	3.45	38.50
1-a	B	166.7	Natural gas	6[2]	3.11	1.87	14.65
29-a	B	166.7	Natural gas	6[2]	3.11	1.87	16.35
28-a	B	166.7	Natural gas	6[2]	3.11	1.87	19.95
32-a	B	166.7	Natural gas	3[2]	1.56	.94	13.90
10-b	C	308	Carbon dioxide	48[3]	28.85	9.37	55.08
12-b	C	308	Carbon dioxide	48[3]	28.85	9.37	54.70
11-b	C	308	Carbon dioxide	36	21.65	7.03	55.48
15-b	C	308	Carbon dioxide	36	21.65	7.03	57.14
9-b	C	308	Carbon dioxide	24	14.43	4.69	56.56
13-b	C	308	Carbon dioxide	24	14.43	4.69	57.12
8-b	C	308	Carbon dioxide	12	7.21	2.34	55.65
14-b	C	308	Carbon dioxide	12	7.21	2.34	57.84
1-b	C	308	Carbon dioxide	6	3.60	1.17	24.40
2-b	C	308	Carbon dioxide	6	3.60	1.17	23.13
3-b	C	308	Carbon dioxide	6	3.60	1.17	22.08
5-b	C	308	Carbon dioxide	6	3.60	1.17	25.90
6-b	C	308	Carbon dioxide	6	3.60	1.17	24.10
7-b	C	308	Carbon dioxide	6	3.60	1.17	21.04

[1] Six holes 0.812 inch in diameter; remaining holes 0.75 inch.
[2] Holes 0.812 inch in diameter.
[3] Holes 0.875 inch in diameter.

TABLE II (continued)—MANHOLE VENTILATION TESTS. AIR CHANGES PER DAY VERSUS CHANGE IN AREA OF VENTILATION OPENINGS AND EFFECT OF SIZE OF MANHOLE

Test No.	Average maximum concentration of gas in manhole, per cent by volume				Duration of tests, days	Average wind velocity, miles per hour	Ventilation air changes in manhole per day
	Top	Middle	Bottom	Average			
3-a	1.17	1.19	1.20	1.19	5.00	1.3	8.50
17-a	3.04	2.95	2.96	2.98	5.00	.2	14.38
15-a	3.78	3.54	3.65	3.66	2.00	.1	11.87
4-a	.93	.95	.92	.94	5.00	2.4	9.31
5-a	1.89	1.92	1.89	1.90	5.00	2.1	8.54
38-a	4.82	5.68	5.00	5.17	1.00	.0	5.74
2-a	2.08	2.03	1.92	2.01	5.00	1.7	4.35
41-a	6.02	6.81	5.94	6.26	1.00	.0	4.62
22-a	5.42	5.30	5.18	5.30	1.00	.2	7.70
25-a	4.91	5.54	5.48	5.31	1.00	4.2	4.35
1-a	3.76	3.72	3.65	3.69	5.00	4.3	2.38
29-a	2.98	3.49	3.04	3.17	2.00	4.1	3.09
28-a	4.54	4.81	4.32	4.56	1.00	2.6	2.62
32-a	3.25	3.75	3.30	3.43	1.00	4.1	2.43
10-b	1.94	1.99	1.89	1.94	2.00	1.6	9.22
12-b	2.33	2.37	2.34	2.35	4.00	1.3	7.56
11-b	4.22	4.16	4.18	4.19	5.00	.4	4.30
15-b	4.73	4.59	4.71	4.67	5.00	.7	3.98
9-b	2.72	2.62	2.62	2.65	3.83	.6	6.93
13-b	5.11	5.08	4.88	5.02	5.83	.6	3.70
8-b	3.67	3.68	3.67	3.67	4.00	2.2	4.92
14-b	5.45	5.22	5.43	5.37	5.00	2.3	3.50
1-b	2.40	3.92	3.94	3.42	3.00	.2	2.32
2-b	2.55	2.62	2.59	2.58	6.00	.5	2.91
3-b	2.12	2.07	2.27	2.15	2.16	.5	3.33
5-b	2.43	2.45	2.49	2.46	6.00	.8	3.42
6-b	2.43	2.51	2.50	2.48	4.00	1.7	3.16
7-b	2.42	2.40	2.39	2.41	4.33	.7	2.84

hole space, the results obtained in the three manholes warrant the general conclusion that as the area of openings in manhole covers is increased, the ventilation also is increased, and they show that a manhole of any given size will be better ventilated and therefore the elimination of any combustibles that may collect in the manhole will be aided by increasing the number of ventilation openings in the cover.

The somewhat erratic points shown in Figure 3 are due largely to other factors, such as varying wind velocity, temperature differences between the outside air and the manhole atmosphere, and weather conditions, which were never the same for any two tests.

The results do not show any decided change in ventilation due to increased capacity or shape of the manhole. The results for the larger manholes, when expressed in terms of air changes per day versus area of ventilation openings in square inches per 100 cubic feet of manhole space, are about the same as for the smaller manhole tested.

As a practical application of the results obtained, the desired number of air changes in a manhole per day may be obtained by adjusting the area of ventilation openings in accordance with the values obtained by experiment and given in Table III.

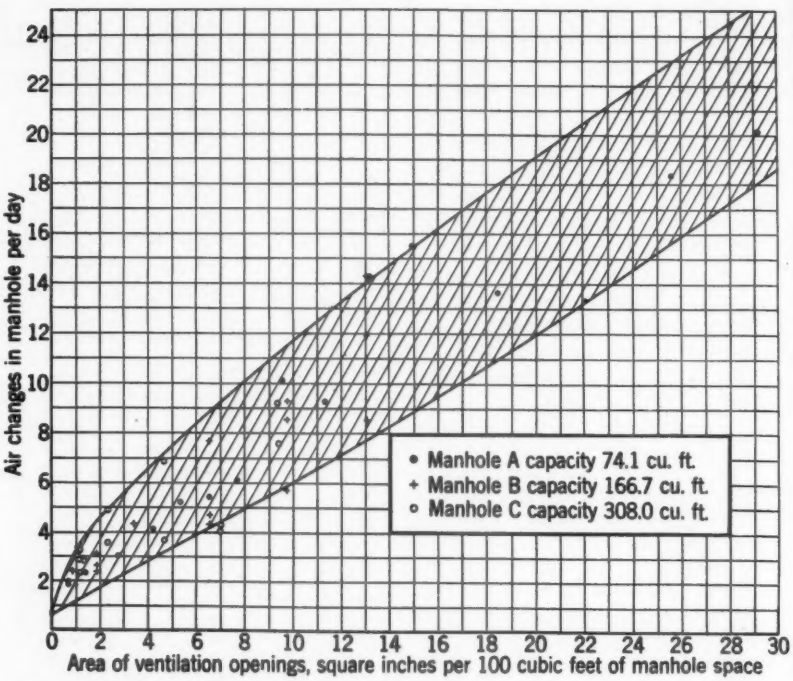
Air changes in manhole per day
Area of ventilation openings, square inches per 100 cubic feet of manhole space
• Manhole A capacity 74.1 cu. ft.
+ Manhole B capacity 166.7 cu. ft.
o Manhole C capacity 308.0 cu. ft.

Figure 3—Ventilation Produced in Manholes by Changing the Area of Ventilation Openings.

TABLE III—Number of Air Changes Obtained in a Manhole by Natural Ventilation When the Area of Ventilation Openings in the Cover is Varied.

A	B		C
Area of ventilation openings in the cover per 100 cubic feet of manhole space, sq. in.	Air changes in the manhole per day Range	Average	Ratio B/A
1	1.5 to 3.0	2.2	2.2
2	1.8 to 4.5	3.2	1.6
3	2.5 to 5.5	4.0	1.3
4	3.0 to 6.5	4.8	1.2
5	3.5 to 7.0	5.3	1.1
6	4.0 to 8.0	6.0	1.0
8	5.0 to 10.0	7.5	.9
10	6.0 to 11.5	8.8	.9
12	7.0 to 13.0	10.0	.8
14	8.5 to 14.5	11.5	.8
16	9.5 to 16.0	12.3	.8

The values given in Table III are of special importance in that they enable the amount of steady leakage of combustibles into a manhole or an underground space to be determined from a knowledge of the capacity of the manhole, the concentration of the combustibles present, and the area of ventilation openings. For example, if the underground opening has a capacity of 200 cubic feet and has 20 square inches of ventilation openings, then the area of ventilation openings per 100 cubic feet of space equals 10. In the table above, it is found that the number of air changes per day for 10 square inches of ventilation openings is 8.8. If analysis of the manhole atmosphere (assuming uniform distribution of the gas in the space) showed 10 per cent of combustibles, then 10 per cent of 200 cubic feet equals 20 cubic feet; and since there are 8.8 air changes per day, the leakage into the manhole equals 8.8 times 20, or 176 cubic feet per day.

Summary

Natural-ventilation tests made in three manholes of varying sizes and design warrant the general conclusion that as the area of openings in the cover of the manhole is increased, the ventilation is also increased; and that a manhole of any given size will be better ventilated and, therefore, the elimination of any combustibles that may collect in the manhole will be aided by increasing the number of ventilation openings in the cover.

A few erratic values obtained in some of the tests were due largely to other factors, such as varying wind velocity, temperature differences between the outside air and the manhole atmosphere, and weather conditions.

The results do not show any decided change in ventilation due to increased capacity or shape of the manhole when the results are expressed in terms of air changes per day versus area of ventilation openings in square inches per 100 cubic feet of manhole space.

R.E.A. Opposes Commission's Order

A hearing of representatives of five Rural Cooperative Electric Associations of Iowa, and representatives of the Independent Telephone interest of Iowa was held before the Iowa Commerce Commission on August 3, relating to the Commission's order of 1916 requiring power companies to pay for metallicizing grounded telephone lines. The action was brought by the cooperatives following Administrator Carmody's statement contained in R.E.A. Release No. 203, dated June 8, prohibiting such charges being included in R.E.A. projects. Representatives of the Independent Telephone interest opposed the action. Attorneys for the rural electric cooperatives were allowed five days to file briefs and the attorneys for the Independent Telephone interest were allowed an additional ten days to file their briefs in reply.

The National Resource Committee's Report on Power in the U. S. A.

THE UNITED STATES not only leads the entire world in the production and use of power, but the electric generating capacity in this country is nearly one-third greater than that of Great Britain and Canada, Germany, France, Russia, Italy and Japan combined, according to the report of the Science Committee of the National Resources Committee transmitted to the President early this week by Chairman Harold L. Ickes.

"Mechanical power," the report says, "has transformed the world in the past century. Compare the conditions at the time of Watt with those at the end of 1935, when domestic consumption of electricity was about 14 billion kilowatt-hours; when over 7¼ million electric refrigerators, 10¼ million vacuum cleaners, 10½ million electric washing machines, 10½ million electric toasters, 20½ million electric irons and 22 million radios were in use in American homes; when over 22½ million automobiles were licensed in this country; and when other comforts and luxuries were made available to all by power and power-driven machines."

The report makes it clear that the rapid development of mechanical power within the last 50 years, as the result of the substitution of a mechanical horsepower costing from $20 to $50 a year for the work-power of 10 to 15 human beings, has been the basic factor in the epoch-making changes that have transformed our whole social and economic structure. Mechanical power has not only made mass production possible, but it has placed a premium upon the superiority of mind over muscle, is gradually abolishing human slavery and enabling man to direct the machinery by which work is performed.

Civilized people of today are dependent upon mechanical power and power-driven machinery for the furniture and furnishings of their homes; for the clothes, hats and shoes they wear; for the materials which enter into the building of their shelters; for their systems of transportation and modes of communication; in fact, for the material content of the present civilization, the report points out. The very food on the table is drawn from farm, forest and stream by highly developed systems of transportation, preserved by machine processes and prepared for use by gas or electricity, all of which depend upon mechanical power.

The report shows that the electric light and power industry has grown from an output of 2½ billion kilowatt-hours in 1902 to 92 billion in 1935. The revenue of the electric utility industry from the sale of energy to consumers increased from 84 million dollars in 1902 to 1,921 million dollars in 1935, or 23 times. During the same period, the capital invested in this industry increased from 505 million to 13,100 million dollars, or 26 times.

The selling price of electricity for household use shows a constant gradual decline, the average charge per kilowatt-hour having been reduced from 25 cents per kilowatt-hour in 1882 to a fraction over 5 cents in 1935. The average use of electricity per customer has increased yearly from 264 kilowatt-hours in 1913 to 673 in 1935. At the same time, the average yearly bill paid by domestic consumers has changed from $22.97 in 1913 to $33.85 in 1935. Thus the Committee's report shows that although the use increased over two and a half times from 1913 to 1935, the cost for the larger amount was only 47 per cent more in 1935 than it was for the smaller amount in 1913. The per capita use of electricity has increased from 30 kilowatt-hours yearly in 1902 to 734 in 1935, the report adds, or more than 15 times as fast as the population growth of the country.

Among other significant figures covered by the report are those which relate to the automotive industry. The motor vehicles of the United States, it is shown, have more available power than all other producers of power combined. In 1935 there were in use in this country 22,589,660 automobiles, 3,511,061 trucks, 66,386 buses and 95,633 motorcycles, a total of 26,262,740 motor vehicles. The entire world, outside of the United States, had in use in 1935 only 11,108,157 motor vehicles.

The report shows the distribution of the mechanical power available in the United States as 1,231 million horsepower in 1935 as follows: motor-vehicles, 965 million; agricultural prime movers, 73 million; locomotives, 88 million; electric central stations, 44,670 thousand; marine, 30 million; industrial power plants, 20 million; airplanes, 3,500 thousand; mines and quarries, 2,750 thousand; electric railway plants, 2,500 thousand, and isolated industrial plants, 1,500 thousand.

Based on these figures and on an estimated population of 127½ million in 1935, man's productive capacity in the United States is indicated in the Committee's report to have increased 50 times during the last 35 years.

"Mechanical power in the short interval of a little more than a century," the report continues, "by transferring reliance from animate to inanimate energy, has revolutionized the whole environment of human life by enabling man to utilize the energy and materials of his environment more effectively. Past civilizations rested upon human slavery; our times are dependent upon mechanical power and energy resources. In the finest civilizations of the past, leisure was afforded to the few by the hard labor of many human slaves. Human slavery has given place in modern civilized lands to mechanical power, which has placed a new valuation upon human life."

"The industrial revolution during the first century of industrialization, and the frequent economic depressions which have paralleled the increased use of power, are not particularly creditable chapters in our history, but the evils which we have experienced during the 'age of power' are not an indictment of power itself but of the inability of men to use it wisely."

The report indicates that the power available for every person in the United States is at least 10 horsepower, when all uses are considered, or about 40 horsepower for each of our 30 million families, the equivalent of 400 human slaves. The available mechanical power, the report adds, has increased from 70 million horsepower in 1900 to over 1 billion in 1935. During the same 35 years the power used on farms has increased about 8 times.

Suggesting that the significance of rural electrification has not been fully

analyzed, the Committee inquires: "Can it be greatly extended if those receiving the benefit are actually expected to pay its cost? What will be the effect of extensive rural electrification upon employment, and will it result in cheaper products and in greater profit to the farmer? Will extensive rural electrification change population trends and, if so, in what direction?" Present practice indicates that the most difficult problem is to render self-supporting rural electric service at a cost which the prospective customer is willing and able to pay, according to the report.

Of the total of nearly 45 million horsepower installed capacity, over 20 million horsepower is available to turn the wheels of American industries. The report shows that from 1899 to 1925 the number of wage earners in the United States nearly doubled, while the power of the machinery installed in industry has increased over three and one-half times per factory worker. The real wage levels of industrialized lands, it is said, are closely related to the power per wage earner.

"Our civilization rests upon the foundation of power-driven machines," the Committee's report concludes. "Mechanical power having changed us from a nation of individuals to a people made up of interdependent groups, has increased our social responsibility.

"In order that humanity at large may gain the greatest benefit from the age of mechanical power, sustained and clear thinking of many minds will be needed. The future power policy of this country must be considered upon a fact-finding basis, without prejudice or passion, and action must be taken slowly and deliberately so as not to hinder progress."

EDITOR'S NOTE: *The foregoing is the news release of the National Resources Committee under date of July 22, 1937. The following excerpts are taken from the report itself:*

Growth of Central Station Service, Increase of Use, Decrease of Cost

The electric central station industry which had its beginning in September, 1882, has developed during the past 54 years so that it ranks fifth among all industries of the country in the amount of money invested and thirteenth in point of number of employees and the value of its product. The following data about this industry are significant:

In the 30-year period from 1902 to 1932 the Federal Power Commission reports that the value of the electric central station industry's plant and equipment increased 25 times; its income from electric service, 23 times; its generating capacity, 29 times; its output, 32 times; and its employees, 8 times.

At the beginning of 1935 the electric utility industry consisted of approximately 1,620 privately owned operating companies and 1,930 municipal systems.

The average selling price of electricity in cents per kilowatt-hours for household use has been reduced from 25 in 1882, to 16.2 in 1902, to 9.1 in 1912, to 7.38 in 1922, to 5.58 in 1932, and to 5.03 in 1935. The United States Bureau of Labor statistics, with the 1913 index as 100, gives the index for 1882 as 287, for 1902 as 186, for 1912 as 104.6, for 1922 as 85, for 1932 as 63.1, and for 1935 as 57.8.

The average cost per kilowatt-hour for large consumers of power has decreased from 1.69 cents in 1921 to 1.29 cents in 1935. The wholesale cost of power delivered to market centers has been estimated by F. F. Fowle, consulting engineer of Chicago, to be 1.25 cents per kilowatt-hour and the cost of distribution 3.05 cents, making the average cost 4.3 cents per kilowatt-hour.

The number of wired homes in this country has increased from about 3 million in 1912, to 10¼ million in 1922, to 20½ million in 1930, and to about 21¼ million in 1935.

The number of customers served by the electric central station industry has increased from 583,000 in 1902, to 3,837,518 in 1912, to 12,709,868 in 1922, to 24,664,000 in 1930, and to 25,370,966 as of December 31, 1935.

Location of Undeveloped Hydro Power

The Federal Power Commission in its Interim Report (Power Series No. 1) of 1935 has estimated the undeveloped water power of the United States at 52,628,900 kilowatts installed capacity, of which about two-thirds of the sites are in the Pacific Northwest and Pacific Southwest, and less than a fourth in the Northeast or Middle West. This report records that the sections of this country which embrace 75 per cent of the population and 80 per cent of the fuel production have about 20 per cent of the undeveloped water power. The sections which comprise 25 per cent of the population and 20 per cent of the fuel resources have about 80 per cent of the undeveloped water power. Forty-two per cent of the undeveloped water power is located in the Pacific Northwest. Of the practical water-power developments of this country about two-thirds are located west of the Mississippi River, that is, in a section of the country where power requirements are only about one-third of the total.

Cost of Power—Steam and Hydro

Cost of Power.—The cost of generating power is only a part of that which must be met by the consumer. A number of factors influence the actual cost, some of which have to do with the investment in the plant, others which relate to the utilization of the plant, and still others which are concerned with operating expenses. Interest, taxes, insurance, and provisions for depreciation and obsolescence influence the fixed charges on plant investment, as do the requirements for reserve capacity and the extent to which the plant is utilized, or plant-capacity factor. Mr. F. F. Fowle in a paper which he presented before the Midwest Power Engineering Conference at Chicago on April 22, 1936, stated that "a complete electric utility of average size requires at present an investment in the order of $365 per kilowatt of installed capacity, or $520 per customer served. Approximately 38 per cent of this amount is invested in generating plants, 24 per cent in transmission lines, and 38 per cent in local distribution systems. * * * The annual charge for interest, taxes, insurance, and depreciation on the investment constituted in 1935 about 65 per cent of the whole cost of service." The 1935 investment of electric utility systems is given by Mr. Fowle as 13 billion dollars, of which 4.8 billion is in generating plants; 3 billion in transmission system; 4.7 billion in distribution; and 500 million in miscellaneous equipment.

In considering the fixed charges for a stationary electric generating plant a number of factors must be considered, among which the following are of major importance:

The power plant proper with its land site, buildings, and machinery. The cost of power plants per kilowatt vary with the type of prime mover, size, location, and design. In general, large steam generating stations may be built at a cost of $75 to $125 per kilowatt capacity. * * *

The cost of transmission lines will depend upon the distance electricity must be transmitted, the amount of electricity to be transmitted, and the cost of rights-of-way. Usually step-down transformers are used at load centers to reduce the voltage to suit local conditions. Then there are distribution sub-stations and feeders to the point of use. Residential customers must be supplied with current at low voltages and in small amounts;

in such cases transmission and distribution costs are often greater than the interest costs for the power station with its equipment. Industrial customers who require large amounts of energy and can frequently take it at high voltage involve less expensive transmission and distribution costs. While average cost data are easily secured, it is exceedingly difficult to calculate the actual cost per kilowatt for any special service, because of the great difficulty of allocating properly, between different classes of service, the numerous items of cost which combine to give the total cost of service.

Provisions for depreciation and obsolescence depend not only upon the actual life of the equipment but upon the useful life which often depends upon progress in the art. Thus in the case of certain power-producing machinery, improvements in design and construction have frequently resulted in conditions which made it practical to replace a prime mover in 3 to 10 years with more modern equipment. Obsolescence, not merely wear, influence equipment replacing costs. Thus adequate allowance for depreciation and obsolescence should be considered in all calculations of power costs.

Needs for reserve capacity depend upon the types of equipment and facilities available for meeting emergencies. Thus interconnection in the case of central electric generating stations has reduced the need for reserve capacity. Cooperation between industrial and utility plants is advantageous in reducing the necessity for spare units in either or both types of plants.

Taxes are an important item in the cost of power. In some fuel-burning plants taxes (local, State, and national) are approaching the cost of fuel. The Edison Electric Institute has reported that the ratio of taxes to operating income has increased from 3.44 per cent in 1902 to 9.46 per cent in 1927 and to 14.1 per cent in 1934.

Fixed charges are practically independent of the load while operating expenses are definitely a function of the output. While superintendence, and to a lesser extent labor, cannot be varied as the load increases or decreases, other operating costs and particularly fuel depend upon the amount of power delivered. Thus in a hydraulic plant, which uses no fuel, the operating costs are practically the same whether the plant carries the maximum load or is standing idle; accordingly, any water which as allowed to pass over the spillway without producing power is a loss. The operating costs in the case of fuel-burning plants are a major item in the cost of power and the economies produced in these plants merit special consideration.

Efficiency and Economy of Steam

Stationary Steam Power Plants.—Our large coal reserves and the efficiency of the steam prime mover indicate that steam power plants will long remain a major factor in the production of mechanical power. In the stationary steam power plant the fixed charges have been going up during recent years while the operating expenses have been going down; yet better engineering has greatly reduced the actual cost per unit of power output at the point of delivery from the power plant. * * *

The best steam-electric power plants are generating, at present, a kilowatt-hour on less than 1 pound of coal as compared with an average of 3 1/3 pounds in 1918, 5 pounds in 1900 and about 10 pounds of coal in 1880. * * *

In 1880 the steam pressure commonly used was 70 pounds per square inch, the steam being saturated—that is, the steam contained evaporated droplets of water. At the beginning of the present century very few stationary plants used superheated steam and the majority operated at steam pressures of 150 pounds per square inch or less. In 1918 the leading and largest electric central stations were operating with steam pressures of 300 pounds per square inch, at steam temperatures of about 650° Fahrenheit, and required fuel containing about 18,500 British Thermal Units (B.t.u.) per kilowatt-hour of net station output, when operating at about 60 per cent load factor. * * * In 1923 a few plants were operating at 350 pounds per square inch steam pressure and some were being constructed for pressures of 400 to 550 pounds per square inch at the boiler. At present there are numerous power plants, industrial as well as public utility, which use steam at pressures of 400 to 1,400 pounds per square inch, with steam temperatures of 750° to 850° Fahrenheit, and which require only about 12,500 B.t.u. per kilowatt-hour of net station output. Binary plants, using mercury vapor and steam as the two fluids, are producing a kilowatt-hour for about 9,000 B.t.u. One industrial plant in this country is operating at steam pressures of about 1,800 pounds per square inch. Investigations are under way at pressures of 2,000 to 4,000 pounds per square inch and at temperatures in excess of 1,000° Fahrenheit. * * *

Modern steam generators, commonly called boilers, are distinctive because of their high capacities or ratings which are made possible through improved water-cooled furnace design. The furnaces of large power plants use no fire-brick lining but are provided with all metal water-cooled walls which represent the most effective part of the entire steam generating equipment. The heating surface of modern boilers, expressed in square feet, is from 8 to 14 times greater than those built in 1900. The rate of evaporation of water per hour in a steam generator has changed from 10,000 pounds in 1880 to 60,000 in 1910, to 300,000 in 1920, and to more than 1¼ million pounds in 1935. High capacity involves lower investment costs. Steam generator efficiencies have increased from 65 in 1900 to 85 or even 90 in 1935. To make high rates of combustion possible, induced and forced draft fans are a necessity. In general, modern high pressure and high temperature steam generators of high ratings are less expensive per unit capacity than the old types of low pressure boilers.

The steam turbine is the most important prime mover for the generation of electricity, as it operates at practically uniform speed, occupies very much less space than a reciprocating steam engine, can be built in very large sizes at low cost, and is very economical in steam consumption. The development of power from fuels by means of steam has been continually in the direction of more powerful prime movers, as operating costs decrease with the size of steam units. With the steam engine there is a limit to the size of a unit beyond which it is impractical to go. The maximum practical size of a reciprocating steam engine for stationary power plants is less than 10,000 kilowatts, while steam turbines of capacities of 160,000 to 212,000 kilowatts are now in operation in central electric stations. The modern steam turbine is highly economical and is used exclusively in large steam-electric plants. Besides the advantages mentioned, its high speed of rotation makes it more economical for driving electrical dynamos, the size and cost of dynamo-electric machinery decreasing as the speed increases. The steam turbine, because of the above-mentioned advantages, has made possible the modern large electric generating station and has also stimulated long-distance electric transmission of electricity. * * *

The economy of old plants has been greatly increased during recent years by

superposing upon available equipment new machines which operate under higher steam pressures. An old plant in Detroit which produced a kilowatt-hour for 19,000 B.t.u. was rebuilt to use steam at 700 pounds per square inch and 825° Fahrenheit; this resulted in reducing the heat consumption per kilowatt-hour to 13,000 B.t.u.

Steam-electric plant economies for 1934, in B.t.u. per kilowatt-hour of net station output, at 60 per cent load factor, are given in the 1936 Interim Report of the National Power Survey of the Federal Power Commission as: 28 per cent of the plants had an economy better than 14,000 B.t.u.; 47.8 per cent, between 14,000 and 18,000; 15 per cent, between 18,000 and 22,000; 4.8 per cent, between 22,000 and 25,000; 3.1 per cent, 25,000 to 30,000; and only about 1 per cent over 30,000 B.t.u.

Mine-Mouth Power Plants Impracticable

Large central generating stations require enormous quantities of cooling water for condensers as well as extensive facilities for receiving and storing coal. The necessity for an adequate supply of cooling water at low temperature practically restricts the location of large steam-electric plants to water sites. * * *

Mine-mouth power plants are practical only in rare instances, as a modern steam-electric plant of 150,000 kilowatts capacity requires as much water for cooling purposes as does a city of about a million inhabitants. Furthermore, mine-mouth location will ordinarily involve electric transmission costs greater than freight charges on fuel; at the same time long transmission lines reduce reliability of service.

Comparison of Water and Steam Power

It must not be inferred, however, that the availability of a waterfall, where water runs to waste, if not used, means a cheap source of power. Water power lacks reliability, as it is affected by meteorological conditions, dry seasons, floods, ice in the water supply, and mechanical and electrical interferences with transmission lines connecting the power with distant markets. The water-power plant involves geographic restrictions, as waterfalls of importance are usually located far from power-consuming areas. However, water power is next in importance to steam in connection with large-scale power generation in stationary power plants.

Water turbines are built in capacities up to 115,000 horsepower in a single unit, and to efficiencies of about 94 per cent. In fact, no prime mover transforms energy into useful power so efficiently as does the modern hydraulic turbine. However, while the hydraulic turbine is a most efficient prime mover, the water power plant involves greater capital risks than is the case with fuel-burning plants. The fixed charges of a hydroelectric plant are usually high as compared with a steam-electric plant; the investment for dams, water storage, long-distance transmission lines to market, and emergency power reserves involve large investment costs. The annual distribution of rainfall and run-off cannot be controlled, and because of this, great extremes of high water and low water occur, making possible the utilization of only a portion of the potential power in a waterfall. Thus hydroelectric stations must use steam or internal-combustion engine stations for emergencies, peak loads, low-water periods, and during floods. Through interconnection of hydroelectric plants and their interspersion with steam plants, the difference in time of seasonal flows of different drainage areas has been taken advantage of and the reliability of service improved.

Water-power plants are usually more expensive than steam plants for equally good service if steam or internal-combustion engine reserves are included in the cost estimates. Ordinarily hydroelectric power plants will involve a cost in excess of $150 per kilowatt capacity as compared with $75 to $125 for steam-electric plants.

F. F. Fowle, consulting engineer of Chicago, in his paper on the Nation's power supply, previously quoted, states that under ordinary conditions a steam plant will deliver current at the power-plant bus at 4 mills per kilowatt-hour as compared with 6.3 mills for a hydroelectric plant. These figures include fixed charges and operating expenses, $85 per kilowatt installed capacity having been assumed as representative for the steam plant and $250 for the hydro plant. When a hydro plant is coordinated with a steam plant the unit costs are reduced. In general, however, fixed charges and reliability insurance are items which should be given major consideration in comparing steam-electric and hydroelectric plants.

Among the disadvantages of the steam plant as compared with the water plant is the fact that turbines and steam generators cannot be placed in service on short notice. Water turbines can be started up and shut down almost instantly without waste of energy provided enough water is available to operate them. Then water storage in a reservoir just above a hydroelectric plant can be used advantageously to take care of load fluctuations. Hydro plants supplemental to steam plants are practical in numerous cases where steam is used for base-load service and hydro prime movers are available for peak or emergency conditions.

In many localities, however, absence of fuel cost does not make up for high fixed charges and low reliability of water power. The high efficiency and low fixed charges now possible in large fuel-burning plants place hydroelectric developments at a disadvantage in most sections of the United States if low power cost is the objective. Water-power plants, due to their high fixed cost, depend even more than do fuel-burning plants upon a high use factor or load factor. * * *

Hydroelectric Plants. — The hydroelectric and steam-electric plants are complementary sources of power. There is need for accurate studies to develop the proper proportion of hydro to steam plants in different sections of the country for the most economical power generation. Present low costs of steam plants necessitate discrimination in developing water power sites.

Hydroelectric plants are practical where good water sites are available, not too far from load centers, with well sustained continuous water flow, or with water storage which can be developed at low cost.

In most regions of this country the hydroelectric plant should be considered as complementary to the steam power plant rather than the main power source. Water power can supply power in certain localities during peak load periods at low cost per kilowatt-hour.

Competing Plants Unwise

As to policies with reference to new plants, either fuel burning or hydro plants, or a combination of the two, are justified when present facilities are inadequate or cannot be extended at a cost less than that of a new plant. Competing plants in one city are usually unwise for economical reasons.

The "Report of Technological Trends and National Policy" of the National Resources Committee, from which the foregoing is taken, may be obtained from the Superintendent of Documents, Washington, D. C., at $1 per copy.

Personnel of E.E.I. Committees for 1937-1938

LISTED herewith and on succeeding pages is the personnel of the technical committees of the Institute for the administrative year 1937-1938. The Operating Committee and Membership Committee appear on the inside of the back cover. There are still a few appointments to the committees to be completed and these will appear in the next issue of the BULLETIN.

In keeping with the practice of the past several years most of the appointments were made early in the summer by President Kellogg, thus obviating any lapse in committee work during the transition from the past administrative year to the present. Practically all of the committees will hold meetings this fall, several of them being scheduled for October and November.

The committee personnel follows:

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L. W. HEATH, Pennsylvania Power & Light Co., Allentown, Pa.
S. P. MACFADDEN, Puget Sound Power & Light Co., Seattle, Wash.
W. R. MCGEACHIN, The Iowa-Nebraska Light & Power Co., Lincoln, Neb.
P. H. POWERS, West Penn Power Co., Pittsburgh, Pa.
HUDSON W. REED, The United Gas Improvement Co., Philadelphia, Pa.
H. M. SAWYER, American Gas & Electric Co., New York, N. Y.
FRANK M. WILKES, Arkansas Power & Light Co., Pine Bluff, Ark.
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M. N. WATERMAN, Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.
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PAPERS ENTERED IN 1937 PRIZE CONTEST TO BE LOANED

The BULLETIN publishes below and on following pages a list of the papers and exhibits entered in the 1937 Prize Awards competition. With the exception of the prize-winning papers (which, in so far as may be practicable are to be published in the BULLETIN during the year), and the entries for the Coffin, Curtis, Hughes and Martin Awards which may be inspected at the general offices, the Institute will be glad to loan to any member company or individual any of the papers listed. Application for loans of papers should be made to the Secretary, Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Requests for loans will be filled in the order of receipt.

PRIZE WINNING PAPERS

H. M. Byllesby Prizes

First Prize—H. O. Hussong, California Oregon Power Company, Medford, Ore.
Second Prize—Messrs L. M. LaPorte and E. M. Wagner, Milwaukee Electric Railway and Light Company, Milwaukee, Wis.
Third Prize—Neil E. Heikes, Public Service Company of Northern Illinois, Chicago, Ill.

B. C. Forbes Prize

Cash Prize—Clarence M. Kilian, Alabama Power Company, Birmingham, Ala.

A. L. Lindemann Prizes

First—Paul L. Meyers, Florida Power and Light Company, Bradenton, Fla.
Second—R. L. Greene, Detroit Edison Company, Detroit, Mich.
Third—George E. Kelley, Portland General Electric Company, Portland, Ore.

James H. McGraw Prizes

First—J. M. Mousson, Safe Harbor Water Power Corporation, Baltimore, Md.
Second—Wallace C. Rudd, Consolidated Edison Company of New York, Inc., New York, N. Y.
Third—Anson D. Marston, Kansas City Power and Light Company, Kansas City, Mo.

PAPERS SUBMITTED BY THE FOLLOWING COMPANIES FOR THE CURTIS, HUGHES AND MARTIN AWARDS ARE AVAILABLE FOR INSPECTION AT THE EDISON ELECTRIC INSTITUTE

(*This Group won prizes or Honorable Mention*)

Augustus D. Curtis Award

Certificate—New Orleans Public Service, Inc., New Orleans, La.

Cash Award—Robert W. Butts

George A. Hughes Award

Cup—Utah Power and Light Co., Salt Lake City, Utah

Cash Award—P. M. Parry

Thomas W. Martin Award

Bronze Plaque—Niagara, Lockport and Ontario Power Company, Buffalo, N. Y.

(*Other entries for Curtis, Hughes and Martin Awards*)

Augustus D. Curtis Award

Commonwealth Edison Company, Chicago, Ill.
Empire District Electric Company, Joplin, Mo.
New York & Queens Electric Light and Power Company, Long Island City, N. Y.
Northern States Power Company, Minneapolis, Minn.
Northwestern Public Service Company, Huron, S. D.
Ohio Public Service Company, Cleveland, Ohio
Portland General Electric Company, Portland, Ore.
Public Service Company of Northern Illinois, New Orleans, La.
Texas Power and Light Company, Dallas, Texas
Union Electric Light and Power Co., St. Louis, Mo.

George A. Hughes Award

Idaho Power Company, Boise, Idaho
Nevada-California Electric Corporation, Riverside, Calif.
New York & Queens Electric Light and Power Co., Long Island City, N. Y.
Niagara, Electric Service Corporation, Buffalo, N. Y.
Niagara-Lockport and Ontario Power Company, Buffalo, N. Y.
Portland General Electric Company, Portland, Ore.
Public Service Company of New Hampshire, Manchester, N. Y.
Tonawanda Power Company, Tonawanda, N. Y.
Union Electric Light and Power Company, St. Louis, Mo.

Thomas W. Martin Award

Alabama Power Company, Birmingham, Ala.
Louisiana Power and Light Company, New Orleans, La.

PAPERS WHICH WILL BE LOANED TO MEMBERS

Submitted by	*Employed By*	*Title of Paper*
Abernathy, T. W.	Kansas City Power and Light Co., Kansas City, Mo.	"Public Relations"
Adkins, E. M.	Jersey Central Power and Light Co., Asbury Park, N. J.	"A Guide to Distribution System Planning"
Alexander, Fred A.	Union Electric Light and Power Co., St. Louis, Mo.	"Advantages of Electric Cookery for Domestic Purposes"
Alm, Bertha L. E.	Central Vermont Public Service Corp., Rutland, Vt.	"Public Relations in the Electric Light and Power Industry"
Ambrose, Sally	Consolidated Edison Co. of New York, New York, N. Y.	"Advantages of Electric Cookery"
Arnot, K. E.	Nebraska Power Co., Omaha, Nebr.	"Public Relations in the Electric Light and Power Industry"
Auchmuty, Hazel F. M.	Mississippi Power Co., Hattiesburg, Miss.	"Public Relations"
Becker, Alan Dee	Union Electric Light and Power Co., St. Louis, Mo.	"Public Relations and Its Possibilities in the Electric Utilities"
Becker, Alan Lee	Union Electric Light and Power Co., St. Louis, Mo.	"The Closing Rush: A Proposal for its Solution"
Billette, Roger	Shawinigan Water and Power Co., Three Rivers, Canada	"Standardization of Copper Wire in Low Voltage Windings of Distribution Transformers"
Blair, Granville	Hartford Electric Light Co., Hartford, Conn.	"Advantages of Electric Cookery for Domestic Purposes"
Boice, Elwyn J.	Syracuse Lighting Co., Inc., Cortland, N. Y.	"Public Relations in the Electric Light and Power Company"
Bolton, Jessie E.	Knoxville Power Co., Alcoa, Tenn.	"Advantages of Electric Cookery for Domestic Purposes"
Both, Henry John	New York & Queens Electric Light & Power Co., Long Island City, N. Y.	"Our Industry and Its Customers"
Bryant, Wellington Earle	Edison Electric Illuminating Co. of Brockton, Brockton, Mass.	"The Development of Public Relations by the Development of Human Progress"
Burns, H. A.	Texas Power and Light Co., Clebourne, Texas	"The Beginning of Electric Utilities and Their Relationship to the Public"
Caldwell, Thomas J.	Connecticut Light & Power Co., Hartford, Conn.	"Public Relations in the Electric Light and Power Industry"
Campbell, John W.	Oklahoma Gas and Electric Co., Kingfisher, Okla.	"Electric Cookery for Domestic Purposes"
Campbell, Malcolm	Consumers Power Co., Jackson, Mich.	"The Public Light and Power Industry and Its 'Relation'"
Cantwell, Roy E.	The Nevada-California Electric Corp., Riverside, Cal.	"Consider the Customer"
Carpenter, Henry H.	Blackstone Valley Gas and Electric Co., Woonsocket, R. I.	"Contact"
Carroll, A. T.	The Carolina Power & Light Co., Raleigh, N. C.	"Public Relations, A Constant Problem"
Caswell, Ralph W.	Public Service Co. of Northern Illinois, Maywood, Ill.	"Design Principles of Rural Electric Lines"
Chalex, John J.	Public Service Co. of Northern Illinois, Chicago, Ill.	"Accounting Procedure to Determine Rate Basis on Fixed Assets"
Christensen, Carol	Idaho Power Co., Twin Falls, Idaho	"Electric Cookery"
Colteryahn, Carl A.	Florida Power & Light Co., Fort Myers, Fla.	"Electric Cookery"
Colteryahn, Carl A.	Florida Power & Light Co., Fort Myers, Fla.	"Public Relations in the Electric Light and Power Industry"
Cooper, J. E. and H. W. Jeffcock	Alabama Power Co., Birmingham, Ala.	"The Special Service Crew of the Alabama Power Company"
Courtney, Edward M.	Niagara Lockport & Ontario Power Co.	"The Employee as the Contacting Agency Between the Public and the Company"
Cravens, Russell C.	Kansas City Power and Light Co., Kansas City, Mo.	"Comments on the Uniform Classification of Accounts for Electric Utility Companies"
Creamer, Harold G.	Public Service Co. of Northern Illinois, Chicago, Ill.	"The Purpose and Method of Instituting a Continuous Inventory"
Critchlow, Roy J.	Utah Power & Light Co., Ogden, Utah	"Public Relations"
Cross, Violet	Memphis Power & Light Co., Memphis, Tenn.	"Public Relations in the Electric Light and Power Industry"
Curley, James Thomas	Consolidated Edison Co. of New York, New York, N. Y.	"Public Relations in the Electric Light and Power Industry"
de Gaetano, O. J.	Phoenix Engineering Corp., New York, N. Y.	"Creating a More Harmonious Relation Between the Utility and the Municipality"
DeRamus, Dora	Birmingham Electric Co., Birmingham, Ala.	"Advantages of Electric Cookery for Domestic Purposes"
Dingledy, P. G.	Pennsylvania Power Co., New Castle, Pa.	"The Personnel Factor in Public Relations"
Docherty, William	New York and Queens Electric Light and Power Co., Long Island City, N. Y.	"Advantages of Domestic Electric Cookery"
Duff, John R.	New York State Electric & Gas Corp., Lancaster, N. Y.	"Problems of the Electric Light and Power Industry"
Dunn, Billy E.	Idaho Power Co., Pocatello, Idaho	"Champions for the Industry"
Earles, Ida G.	Northern New York Utilities, Inc., Rome, N. Y.	"The 'Spare Tire' of the Non-Merchandising Utility"
Easter, R. R.	Portland General Electric Co., Hillsboro, Ore.	"The District Representative Plan—Proposed for Portland General Electric Company"
Eberle, Edward Radcliffe	Public Service Electric and Gas Co. of N. J., Newark, N. J.	"Current Problems Point to the Need for an Application of Merchandising Principles in the Electric Light and Power Industry"
Edgar, Wesley B.	Broad River Power Co., Columbia, S. C.	"Development of Property Records and Accounting"
Fahnestock, James H.	People's Gas and Electric Co., Oswego, N. Y.	"Let's Make Friends with Our Customers"
Falk, Howard	Public Service Electric and Gas Co., Newark, N. J.	"A Symbol of Service"
Fargo, W. Robert	Portland General Electric Co., Portland, Ore.	"The Kitchen Plan, Its Cause and Effect"
Fitzgerald, William A.	Gary Heat, Light & Water Co., Gary, Ind.	"Public Relations in the Electric Light and Power Industry"
Foreman, Earl	Central Illinois Light Co., Peoria, Ill.	"Humanity Versus Utility"

PAPERS WHICH WILL BE LOANED TO MEMBERS

Submitted by	*Employed By*	*Title of Paper*
Fraga, Dorothy Frances	Consolidated Edison Co., Inc., New York, N. Y.	"Public Relations"
Franck, Albert J.	Queens Boro Gas & Electric Co., Far Rockaway, N. Y.	"The Absolute Essential in Bettering Public Relations"
Gahnkin, Valentine G.	Brooklyn Edison Co., Brooklyn, N. Y.	"Study of H P Unit Superposed Installations and Transfer of L P Units in a Large Metropolitan Company"
Garbarino, Stephen L.	Pennsylvania Power and Light Co., Allentown, Pa.	"Public Relations and Industrial Development"
Garner, C. L.	Puget Sound Power and Light Co., Vashon, Wash.	"Public Understanding Vital—To Favorable Public Relation"
George, J. Lester	Pennsylvania Electric Co., Philipsburg, Pa.	"Good Will Through Education"
Gibson, Gertrude	Consumers Power Co., Flint, Mich.	"The Three Musketeers of Electric Cookery"
Grantz, Frank P.	Louisville Gas and Electric Co., Louisville, Ky.	"Public Relations Through the Employees"
Graves, George R.	Florida Power and Light Co., Fort Lauderdale, Fla.	"Common Sense Engineering"
Greely, Charles H.	Northwestern Electric Co., Vancouver, Wash.	"Goodwill—How To Secure It"
Grewe, Alois J.	Union Electric Light and Power Co., St. Louis, Mo.	"Advantages of Electric Cookery for Domestic Purposes"
Hafemann, William P.	Public Service Electric and Gas Co., Hoboken, N. J.	"After the First Impression"
Hampson, H. O.	Nebraska Power Co., Omaha, Nebr.	"Every Customer A Friend"
Hansen, William V. A.	Blackstone Valley Gas and Electric Co., Woonsocket, R. I.	"Public Relations in the Electric Light and Power Industry"
Harris, Mrs. Percy M.	Georgia Power Co., Macon, Ga.	"Advantages of Electric Cookery for Domestic Purposes"
Hart, G. E.	Public Service Co. of Northern Illinois, Chicago, Ill.	"What Causes Radio Interference"
Heinemann, Fred. E.	New York & Queens Electric Light and Power Co., Long Island City, N. Y.	"Public Relations"
Heller, Clifford F.	Pennsylvania Power and Light Co., Allentown, Pa.	"Public Relations"
Hennessy, L. I.	San Diego Consolidated Gas and Electric Co., San Diego, Cal.	"Expert Guidance in Public Relations"
Hensel, Robert W.	Pacific Power and Light Co., Portland, Ore.	"Reversing the Golden Rule"
Hickey, Roger J.	Virginia Electric and Power Co., Petersburg, Va.	"Public Relations in the Electric Light and Power Industry"
Hill, Raymond S.	Central Arizona Light and ower Co., Phoenix, Ariz.	"New Frontiers in Public Relations"
Hill, W. W.	Northern States Power Co., Minneapolis, Minn.	"We Face the Future"
Hilligoss, Kenneth	Northern States Power Co., Grand Forks, N. D.	"Better Public Relations in the Electric Light and Power Industry"
Hirshberger, Alfred	Philadelphia Electric Co., Philadelphia, Pa.	"Cook with Electric and Save the Juices"
House, Mrs. Thelma S.	New York State Electric and Gas Corp., Norwich, N. Y.	"Advantages of Electric Cookery for Domestic Purposes"
Huber, James R.	Nevada California Power Corp., Riverside, Cal.	"Improving Our Public Relationship"
James, Lillian A.	Memphis Power and Light Co., Memphis, Tenn.	"Advantages of Electric Cookery for Domestic Purposes"
Jeffcock, H. W. and J. E. Cooper	Alabama Power Co., Birmingham, Ala.	"The Special Service Crew of the Alabama Power Company"
Jennings, Charles W.	Westchester Lighting Co., Ossining, N. Y.	"Employees and Public Utility Relationships"
Jessiman, A. C.	Kaministiquia Power Co., Ltd., Fort William, Ont.	"Electric Cookery"
Johnson, Margaret Fell	Alabama Power Co., Birmingham, Ala.	"Advantages of Electric Cookery for Domestic Purposes"
Johnson, Wanda Elizabeth	Tennessee Electric Power Co., Chattanooga, Tenn.	"Electric Cookery"
Jones, W. F.	Nevada-Calif. Electric Corp., Riverside, Calif.	"Accountability Through Accounting"
Jordan, Kate Bates	Union Electric Light and Power Co., St. Louis, Mo.	"Advantages of Electric Cookery for Domestic Purposes"
Kaminsky, Helen E.	New York State Electric and Gas Corp., Endicott, N. Y.	"Public Relations in the Electric Light and Power Industry"
Kavanagh, Andrew J.	New York State Electric and Gas Corp., Plattsburg, N. Y.	"Public Relations = Printers' Ink + Personnel!"
Kellagher, Charles B.	Buffalo General Electric Co., Buffalo, N. Y.	"Electric Cookery"
Kelley, George E.	Portland General Electric Co., Portland, Ore.	"Kitchen Planning and Public Relations"
Kelsey, Everett A.	Public Service Electric & Gas Co., Newark, N. J.	"The Advantages of Electric Cookery for Domestic Purposes"
Kenney, Lawrence M.	Milwaukee Electric Railway and Light Co., Milwaukee, Wis.	"Advantages of Electric Cookery for Domestic Purposes"
King, Dana G.	Mississippi Power Co., Gulfport, Miss.	"Our Public"
King, J. E. and Porter, F. J.	New York & Queens Electric Light & Power Co., Long Island City, N. Y.	"Organizing for Improved Public Relations"
Kinsinger, Grace E.	Central Illinois Light Co., Peoria, Ill.	"Public Relations"
Knarr, Virginia A.	The Cincinnati Gas & Electric Co., Cincinnati, Ohio.	"Service"
Krausnick, Charles	Union Electric Light and Power Company, Webster Groves, Mo.	"Electric Cookery"
Kuhles, Rhea M.	Detroit Edison Co., Mt. Clemens, Mich.	"Public Relations and the Repair Department"
Lane, Malcolm	Alabama Power Co., Attalla, Ala.	"I Learned About Women Through Utilities"
LaPorte, L. M. and E. M. Wagner	Milwaukee Electric Railway & Light Co., Milwaukee, Wis.	"Twenty Customers' Accounting Department Practices Which Improve Public Relations"
LaRose, Emmet J.	Louisiana Power and Light Co., Donaldsonville, La.	"Electric Cookery"
Laspisa, Jake	Public Service Co. of Northern Illinois, Maywood, Ill.	"Public Relations in the Electric Light and Power Industry"
Lavoie, G. A.	Lawrence Power Co., Rimouski, P. Q.	"Public Relations"
LeBlanc, Day	Louisiana Power and Light Co., New Orleans, La.	"Advantages of Electric Cookery for Domestic Purposes"

PAPERS WHICH WILL BE LOANED TO MEMBERS

Submitted by	*Employed By*	*Title of Paper*
Lee, Ralph	Utah Power and Light Co., Salt Lake City, Utah	"Control of Frequency and Load Distribution on Our Interconnected System"
Leibler, Katherine	Union Electric Light and Power Co., St. Louis, Mo.	"Advantages of Electric Cookery for Domestic Purposes"
Lewis, Dempster C.	Utica Gas & Electric Co., Utica, N. Y.	"Distribution Transformer Voltage Taps"
Lewis, Josephine E.	Alabama Power Co., Birmingham, Ala.	"The Social Advantages of Electric Cookery"
Lively, George R.	Syracuse Lighting Co., Inc., Syracuse, N. Y.	"Feed the Roots and the Tree Bears Fruit"
Livermore, Ernest R.	Northwestern Electric Co., Portland, Ore.	"Do Unto Others"
Long, Gertrude	Niagara, Lockport and Ontario Power Co., Avon, N. Y.	"Advantages of Electric Cookery for Domestic Purposes"
Long, L. W.	Bay City Division of Consumers Power Co., Bay City, Mich.	"Utility—A Synonym for Service"
Lunde, G. A.	Northern States Power Co., Fargo, N. D.	"Public Relationship in the Power Industry"
MacKinnon, R. H.	Public Service Co. of Northern Illinois, Chicago, Ill.	"Analysis of Burton Bridge Line"
McClure, Earl L.	Milwaukee Electric Railway and Light Co., Milwaukee, Wis.	"Fault Currents Before and After They Occur with the Automatic Oscillograph"
McFarlin, Vernon S.	The Edison Electric Illuminating Co. of Boston, Boston, Mass.	"Calculation of the Life of Wood Poles"
McGill, Lillian B.	Twin State Gas and Electric Co., St. Johnsbury, Vt.	"Advantages of Electric Cookery for Domestic Purposes"
McKinnon, R. A.	Western Colorado Power Co., Durango, Colo.	"What Do You Think"
McMillen, David S.	Consolidated Edison Co. of New York, New York, N. Y.	"Public Relations"
Magee, Elsie	Consumers Power Co., Big Rapids, Mich.	"Electric Cookery"
Mannix, Marjorie	Public Service Co. of Oklahoma, Tulsa, Okla.	"Advantages of Electric Cookery for Domestic Purposes"
Meldahl, Carl J.	Minneapolis General Electric Co., Minneapolis, Minn.	"Teach Us 'Why'"
Mew, Dorothy	Florida Power and Light Co., Miami, Fla.	"Advantages of Electric Cookery for Domestic Purposes"
Mikulski, John J.	Buffalo General Electric Co., Buffalo, N. Y.	"The Electric Range"
Mikulski, John J.	Buffalo General Electric Co., Buffalo, N. Y.	"Types of People with High Bill Complaints"
Miller, William J.	Public Service Electric and Gas Co., Trenton, N. J.	"Future Public Relations in the Electric Utility Industry"
Milner, Perrie Lou	Mississippi Power Co., Laurel, Miss.	"At the Turn of a Switch"
Moberger, Carl G.	Edison Electric Illuminating Co. of Boston, Boston, Mass.	"Today's Problem in Public Relations in the Electric Light and Power Industry"
Moylan, John R.	Atlantic City Electric Co., Atlantic City, N. J.	"Does the Industry Need National Public Relations?"
Mudge, William L., Jr.	The United Gas Improvement Company, Philadelphia, Pa.	"Our Community Interest"
Murchison, J. L.	Texas Power and Light Co., Dallas, Texas	"The Public and the Utilities"
Muzzy, Fay L.	Public Service Electric and Gas Co., Passaic, N. J.	"Electric Cookery"
Nelson, Ruth G.	Northern States Power Co., Sioux Falls, S. D.	"Public Relations"
Nolan, John F.	Brooklyn Edison Co., Inc., Brooklyn, N. Y.	"Public Relations in the Electric Light and Power Industry"
Noser, J. A.	Union Electric Light and Power Co., St. Louis, Mo.	"Electric Cookery"
Nuelle, Frank J.	Union Electric Light and Power Co., St. Louis, Mo.	"The Advantages of Electric Cookery for Domestic Purposes"
Nunn, Harold F.	The Niagara Falls Power Co., Niagara Falls, N. Y.	"Public Relations and the Minority"
Ogren, Carl V.	Northern States Power Co., Red Wing, Minn.	"Public Relations"
Olson, Alice G.	Northern States Power Co., Red Wing, Minn.	"Advantages of Electric Cookery for Domestic Purposes"
Parrish, Edna	Utah Power and Light Co., Salt Lake City, Utah	"Advantages of Electric Cookery"
Paschall, Jess P.	Portland Electric Power Co., Portland, Ore.	"I'm Sorry—But"
Perry, Florence D.	Alabama Power Company, Birmingham, Ala.	"Be a Friend and Have a Friend"
Porter, F. J. and J. E. King	New York & Queens Electric Light and Power Co., Long Island City, N. Y.	"Organizing for Improved Public Relations"
Prims, Edwin M.	Public Service Co. of Northern Illinois, Chicago, Ill.	"Effect of Collection Policy on Public Relations"
Qualls, E. H.	Union Electric Light and Power Co., St. Louis, Mo.	"Public Relations in the Electric Light and Power Industry"
Ray, Mrs. John R.	Arkansas Power and Light Co., Pine Bluff, Ark.	"Advantages of Electric Cookery for Domestic Purposes"
Reed, Ezekiel C.	Atlantic City Electric Co., Atlantic City, N. J.	"Mr. Average Man Views the Public Utilities"
Reese, D. T.	Ohio Public Service Co., Mansfield, Ohio	"Public Relations"
Reese, Floyd H.	New York State Electric and Gas Corp., Elmira, N. Y.	"Better Public Relations Through Better Employees"
Roberts, E. A.	Southwestern Public Service Co., Carlsbad, N. M.	"Public Relations"
Rocher, Lillian B.	California Oregon Power Co., Medford, Ore.	"Public Relations in the Power and Light Industry"
Root, Cecil A.	Northwestern Electric Co., Vancouver, Wash.	"Public Relations in the Electric Light and Power Industry"
Roser, Evan D.	Florida Power & Light Co., Miami, Fla.	"Accounting Charts"
Ross, Edison H.	New York State Electric & Gas Corp., Brewster, N. Y.	"Improved Meter Control"
Ross, Joseph E. A.	Consolidated Edison Co. of N. Y., Inc., New York, N. Y.	"Miscellaneous Billing—Job Work Sales"
Rowley, J. Joseph	Consolidated Edison Co. of N. Y., Bronx, N. Y.	"Public Relations in the Electric Light and Power Company"
Sackett, Carl V.	Niagara, Lockport & Ontario Power Co., Avon, N. Y.	"Advantages of Electric Cookery for Domestic Purposes"
Sargent, Norwood V.	Boston Edison Co., Boston, Mass.	"Electricity—The 'Sunshine' Fuel"
Scheu, Walter A.	Long Island Lighting Co., Mineola, N. Y.	"A Criticism of Our Public Relations Methods"
Schuchart, Bertha	Union Electric Light and Power Co., Webster Groves, Mo.	"Advantages of Electric Cookery for Domestic Purposes"

PAPERS WHICH WILL BE LOANED TO MEMBERS

Submitted by	*Employed By*	*Title of Paper*
Schugren, Virginia	Pacific Gas and Electric Co., San Francisco, Cal.	"What's Watt—For Men Only"
Schulze, Raymond C. R.	Public Service Electric & Gas Co., Newark, N. J.	"Calculation of Load Division in Transmission Networks"
Schweitzer, George	Interstate Light & Power Co., Galena, Ill.	"Public Relations"
Shea, R. D.	Pacific Gas and Electric Co., San Francisco, Cal.	"The Problem of Improving Public Relations in the Electric Utility Business is One of Utility Organization"
Simpson, Rosemary B.	The Detroit Edison Co., Detroit, Mich.	"A Million Housewives Can't Be Wrong"
Smith, Albert B.	The Connecticut Light and Power Co., Meriden, Conn.	"The Employee's Part in Public R lations in the Electric Light and Power Industry"
Smith, E. D.	Dayton Power and Light Co., Dayton, Ohio	"The Advantages of Electric Cooking for Domestic Purposes"
Smith, H. L.	Pacific Gas & Electric Co., San Francisco, Cal.	"Public Fear in Public Relations"
Smith, Marion	Florida Power and Light Co., Fort Meyers, Fla.	"Advantages of Electric Cookery for Domestic Purposes"
Snell, Thomas A.	Public Service Co. of Northern Illinois, Chicago, Ill.	"Modern Methods of Meter Testing"
Snyder, Creighton C.	Portland General Electric Co., Portland, Ore.	"Advantages of Electric Cookery for Domestic Purposes"
Squires, Chauncey	New York State Electric & Gas Corp., Walton, N. Y.	"Consuming Kilowatts"
Stanton, Gilbert L.	Idaho Power Co., Boise, Idaho	"On the Spot"
Stearns, Arthur D., Jr.	Public Service Electric & Gas Co., Newark, N. J.	"Private Ownership Benefits the Customer"
Stedman, J. B.	Community Public Service Co., Fort Worth, Texas	"The Employee and Good Public Relations"
Stevens, Joseph W.	New York State Electric & Gas Corp., Brewster, N. Y.	"Improved Meter Order"
Stice, Martha Jane	Pacific Gas and Electric Co., San Francisco, Cal.	"Women in Public Relations"
Thomas, Frank J.	Philadelphia Electric Co., Philadelphia, Pa.	"Public Relations"
Tinker, Foster M.	Lawrence Gas and Electric Co., Lawrence, Mass.	"Public Relations"
Tobin, Bernard F.	New York & Queens Electric Light & Power Co., Long Island City, N. Y.	"Fresh Roasted Coffee"
Townsend, Walter A.	Central Illinois Light Co., Springfield, Ill.	"Can We Put the Electric Industry Into a New Role in the Interesting Drama of Public Relations?"
Trodahl, A. J.	Commonwealth Edison Co., Chicago, Ill.	"Domestic Hot Water Tanks"
Tully, George F., Jr.	Central Vermont Public Service Corp., Rutland, Vt.	"Public Relations"
Turner, Floyd E.	Birmingham Electric Co., Birmingham, Ala.	"Comments on Determining an Adequate Program for the Replacement of Overhead Services"
Tyler, George F.	Connecticut Power Co., Stamford, Conn.	"Public Relations in the Electric Light and Power Industry"
Uhlig, Edward M.	Nevada-California Electric Corp., Riverside, Cal.	"Rate Schedule Standardization for Better Public Relations"
Vandervelde, Harold	Commonwealth Edison Co., Chicago, Ill.	"Ideal Customer Relations and Delinquent Accounts"
Villa, Mrs. Amy	Idaho Power Co., Twin Falls, Idaho	"Advantages of Electric Cookery"
Vincent, Roy F.	Niagara Falls Power Co., Niagara Falls, N. Y.	"Public Relations—Its Scope in the Utilities"
Vosbrink, Oscar J.	Union Electric Light and Power Co., St. Louis, Mo.	"A Public-Relation Conscious Credit Department"
Wagoner, C. D.	General Electric Co., Schenectady, N. Y.	"Public Relations"
Weitzman, Harry A.	Rochester Gas and Electric Corp., Rochester, N. Y.	"Public Relations and Service"
Weitzman, Harry A.	Rochester Gas and Electric Corp., Rochester, N. Y.	"Public Relations and the Public Utility Employee"
White, George F.	Webster and Southbridge Gas and Electric Corp., Webster, Mass.	"A Few Suggestions for a Program of Public Relations"
White, Vilate Currie	Utah Power and Light Co., Salt Lake City, Utah	"Electric Cookery"
Williams, Inez C.	Utah Power and Light Co., Salt Lake City, Utah	"Public Relations"
Williams, Ruth W.	Detroit Edison Co., Detroit, Mich.	"The 'Why' of Electric Cooking"
Willis, Donald	Puget Sound Power and Light Co., Sumner, Wash.	"Advantages of Electric Cookery for Domestic Purposes"
Wolfe, Harriett C.	Dayton Power and Light Co., Dayton, Ohio	"Advantages of Electric Cookery for Domestic Purposes"
Woolley, Bret R.	Utah Power and Light Co., Salt Lake City, Utah	"Human Relations of Electric Utilities"

THE LIGHT BURNS ON

Sometimes those of us who shoot through the Manhattan labyrinth in subways or ride the dawn on silver wings must wonder if perchance we are not living in a mythologic world. And when lightning struck the Edison Memorial Tower at Menlo Park the other day, felling to the ground the unfinished monument to the genius who harnessed the lightnings to the everyday service of man, it seemed as if the old gods, the jealous Jove, the fiery-tempered Vulcan, might still be at their ancient tricks. Are not the legends full of such exhibitions of Olympian anger, forged into lightning bolts to destroy the earthly beings who aspired too high? The tower commemorating the audacity of the wizard of Menlo Park was erected on the very spot of the work bench where Edison perfected the first incandescent bulb. It was not finished when the lightning shattered it. But if the old gods gloated to see the steel framework ripped like paper by their electric power, the modern Prometheus, like the first fire-bringer, had the last laugh.

For when the wreckage was cleared away it was found that the light at the base of the tower was still burning. The glass case which enclosed it was broken, but Edison's little bulb was intact, alight, and, one likes to believe, defiant. Out of a new item very similar to this Aeschylus made his greatest drama.—*New York Times, Aug. 13, 1937.*

POWER SALES ITEMS

AIR CONDITIONING

"Rayon and Air Conditioning," by L. L. Lewis. *Heating, Piping & Air Conditioning,* July, 1937, p. 427. Keeney Publishing Co., 6 North Michigan Ave., Chicago, Ill., Publishers.

How rayon is made—air conditioning requirements of the process.

"Air Conditioning In a Meat Packing Plant," by L. C. Leslie, E. J. Berlet. *Ice & Refrigeration,* July, 1937, p. 37. Nickerson & Collins Co., 149 Broadway, New York City; Chicago, 435 North Waller Ave., Publishers.

"Pumping Head on Air Conditioning System Reduced by Using Siphon," by W. Goodman. *Heating, Piping & Air Conditioning,* July, 1937, p. 418. Keeney Publishing Co., 6 North Michigan Ave., Chicago, Ill., Publishers.

COAL MINES

"Mine Buys Its Power and Sells Its Coal," by F. O. Harris and B. C. Hylton, Lake Superior Coal Co., Superior, W. Va. *Electrical World,* July 17, 1937, p. 39. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Heavy capital outlay for new power facilities averted and lower operating cost obtained.

DIESEL ENGINES

"Denton, Texas Municipal Plant Record of Power Progress," by Orville Adams. *Diesel Power,* June, 1937, p. 402. Diesel Publications, Inc., 192 Lexington Ave., New York City, Publishers.

Production record of Diesel engines installed in 1930, 1933 and 1936.

"Oil Engine Power Costs Report of the ASME Sub-Committee." *Diesel Power,* June, 1937, p. 406. Diesel Publications, Inc., 192 Lexington Ave., New York City, Publishers.

Four articles analyzing the report with regard to age:

What is the effect of age on Diesel operation?
How engine age affects fuel oil consumption.
How engine age affects lubricating oil consumption.
How engine age affects maintenance costs.

INDUSTRIAL ELECTRIFICATION

"Industrial Electrification." *Electrical World,* June 5, 1937, p. 116. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Five items which contain ideas for power sales:

1. Spinning control boosts production.
2. Electronic regulators stop light flicker.
3. Arc-welded pipe joints show strength.
4. Capacitators save 54% of cost annually.
5. Motorized sorter separates walnuts.

"Industrial Electrification." *Electrical World,* July 3, 1937, p. 74. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Five items which contain ideas for power sales:

Capacity effects upset control system.
Electric hardening furnace quenches parts automatically.
Electric heat boosts press production.
Welded pen points build mass demand.
Unit bus assembles simplify installation.

"Industrial Electrification." *Electrical World,* July 17, 1937, p. 77. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Four items which contain ideas for power sales:

Control heating bath within 1 degree.
Maintenance hints on oil switches.
Built battery truck for tunnel hauls.
Thirty-five-foot candles for machine shop.

LIGHTING

"The Amount of Luminous and of Ultra-Violet Solar Radiation received on Certain Vertical Planes," by W. Kunerth, R. D. Miller, H. T. Hurley. *Transactions of Illuminating Engineering Society,* March, 1937, p. 315. Illuminating Engineering Society, 51 Madison Ave., New York City, Publishers.

"Report on Lighting in the Shoe Manufacturing Industry." *Transactions of the Illuminating Engineering Society,* March, 1937, p. 289. Illuminating Engineering Society, 51 Madison Ave., New York City, Publishers.

Submitted by the Committee on Industrial and School Lighting of the IES.

"Modernized Industrial Lighting," by H. M. Hays. *Electric Journal,* April, 1937, p. 158. Electric Journal, 530 Fernando St., Pittsburgh, Pa., Publishers.

The high-intensity, mercury-vapor lamps are now obtainable in different sizes and with reflector units for different combinations of mercury and mazda lamps.

"What Good Lighting Means to Industrialists," by D. M. Warren, A. K. Gaetjens. *Electrical World,* June 19, 1937, p. 2170. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

PAPER MILLS

"Hints on Selecting Paper Mill Drives," by J. L. Rylander and M. R. Long, Westinghouse Electric & Manufacturing Company. *Electrical World,* July 3, 1937, p. 51. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Abstract from paper presented at a meeting of Technical Association of Pulp and Paper Industry.

PLATE MILLS

"New 100" Semi-Continuous Plate Mill—Carnegie-Illinois Steel Corporation—Homestead, Pa." *Iron & Steel Engineer,* June, 1937, p. H-1. Association of Iron and Steel Engineers, 1018 Empire Bldg., Pittsburgh, Pa., Publishers.

Description and plan view of the new 100" plate mill.

POWER FACTOR

"Power Factor, Power Bills and Low Voltage." *Electrical World,* March 13, 1937, p. 47. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Power factor correction in Chevrolet plant at Muncie, Ind., improves voltage conditions and decreases power bill.

"Chrysler Keeps After Power Factor," by H. E. Watterson, Chrysler Motor Corporation. *Electrical World,* April 24, 1937, p. 47. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Power factor correction means more efficient use of energy at machine drives, full utilization of transformer capacity and reduces power bill.

POWER SALES

"National Power Sales Advertising Gaining Favor," by R. D. Hayes, Chairman National Power Sales Publicity Committee. *Electrical World,* July 17, 1937, p. 53. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City, Publishers.

Electric utility industry will probably advertise their product on a national scale within a year.

REFRIGERATION

"Steam-Jet Refrigeration," by J. C. Bertsch. *Ice & Refrigeration,* July, 1937, p. 5. Nickerson & Collins Co., 149 Broadway, New York City; Chicago, 435 North Waller Ave., Publishers.

Three classes of applied refrigeration—the Follain three stage system.

"Refrigeration System in Narragansett Brewing Plant," by W. Jones. *Ice & Refrigeration,* July, 1937, p. 8. Nickerson & Collins Co., 149 Broadway, New York City; Chicago, 435 North Waller Ave., Publishers.

Illustrated description of new refrigerating equipment installed in brewery as part of an expansion and modernization program.

STEEL PLANTS

"Developments in Steel Plant Distribution Systems," by M. H. Hobbs, Westinghouse Electric & Manufacturing Co. *Iron & Steel Engineer,* June, 1937, p. 22. Association of Iron and Steel Engineers, 1018 Empire Bldg., Pittsburgh, Pa., Publishers.

Paper covering some of the factors which determine the design of a distribution system, some typical systems and modern switchgear equipment.

STRIP MILLS

"Electrical Operation of Cold Strip Mills," by A. F. Kenyon, Westinghouse Electric & Manufacturing Co. *Iron and Steel Engineer,* July, 1937, p. 27. Association of Iron and Steel Engineers, 1018 Empire Bldg., Pittsburgh, Pa., Publishers.

Operating results of electrical equipment in various cold rolling mills.

WELDING

"200-Inch Telescope Being Welded Electrically—Mounting Structure for the 200-Inch Telescope Being Built on Mt. Palomar, in Southern California, Will Consist of Electric-Arc-Welded Units." *Electrical Engineering,* July, 1937, p. 783. American Institute of Electrical Engineers, 33 West 39th Street, New York City, Publishers.

Retirements Reserve

(Continued from page 322)

beyond control. Your rates will be reduced voluntarily whenever possible."

The same obligation is assumed when management collects, as a percentage of rates, *only* sufficient funds to provide a Retirement Reserve and finance adequate maintenance.

There is no difference in the obligation of management under either plan, but *there is a decided difference in the amount set aside.* Why this should be the writer has been unable to discover, but Depreciation Reserves accrued according to precedent by the straight-line (or the sinking fund) method require the appropriation of a far greater amount of income than is necessary under a Retirement Reserve policy—without any apparent advantages.

The substitution of a Retirement Reserve, based on the facts of experience, plus any changes in policy necessary to insure adequate maintenance, for a Depreciation Reserve based upon any so-called life-table is more than desirable—it appears to be necessary as an advance towards honest accounting and a logical step towards successful fulfillment of the promise to customers, investors, owners, and employees that assumption of the duties of management entails.

CONVENTIONS AND MEETINGS

SEPTEMBER

8-10 Pennsylvania Electric Association, Bedford Springs Hotel, Bedford Springs, Pa.

13-14 Wisconsin Utilities Association, Transportation Section, Lawsonia Hotel, Green Lake, Wis.

13-15 Rocky Mountain Electrical League, Estes Park, Colo.

16-17 Empire State Gas and Electric Association, Saranac Inn, Saranac Lake, N. Y.

17-18 Public Utilities Association of West Virginia, Greenbrier Hotel, White Sulphur Springs, W. Va.

24-25 Wisconsin Utilities Association, Accounting Section, Lawsonia Hotel, Green Lake, Wis.

27-30 American Gas Association, Cleveland, Ohio.

27-30 Illuminating Engineering Society, Greenbrier Hotel, White Sulphur, W. Va.

OCTOBER

1 American Gas Association, Cleveland, Ohio.

11-12 Electrical Equipment Committee, Chamber of Commerce Grill, Terminal Tower Building, Cleveland, Ohio.

11-15 National Safety Council Congress, Kansas City, Mo.

12-13 Transmission and Distribution Committee, Chamber of Commerce Grill, Terminal Tower Building, Cleveland, Ohio.

17-20 National Electrical Wholesalers Association, Cleveland, Ohio.

21-23 Indiana Electric Association, French Lick Springs Hotel, French Lick Springs, Ind.

24-29 National Electrical Manufacturers Association, Chicago, Ill.

NOVEMBER

8-10 Accounting Committee conclave, Detroit, Mich.

World's Fair Farm

(Continued from page 326)

electrically operated, will keep them growing in full vigor.

The barns will be fully electrified, from the electric screens which will keep out insects to electric hoists and carriers for hay and grain. Machinery in the dairy will be operated by electricity throughout, and will include an air cleaner, water cooler, cream separator, tester, pasteurizer, milk irradiator and bottler. The garage will have an electric door opener and burglar alarm. The shop and utility room will have a full assortment of machine and woodworking tools such as are needed on every farm, all operated electrically.

The farm home will be completely electrified. It will include an all-electric kitchen and laundry, the latest in modern lighting, and dozens of smaller electrical household appliances which help to raise the living standard in any home. It will provide ample demonstration of the new freedom which electricity can offer the housewife. From it she will learn the many ways in which she may give herself more time to do the things she wants to do instead of spending all her time at household chores.

For purposes of comparison the house will also include a typical old-fashioned farm kitchen such as was found in most farm homes throughout the country less than half a century ago. Visitors will thus be able to visualize for themselves the unremitting toil which all farm women faced before the advent of electric service.

With visitors expected by the Fair management from each of the forty-eight states and from many foreign countries, the electric farm will prove of intense interest. Hundreds of thousands of people will see in it dozens of practical suggestions as to how they can take advantage of electric equipment to better their own living conditions on their own farms. The city dweller, whose cost of living depends in large part on the farmer's production costs, will naturally be deeply interested in seeing the newest devices by which these production costs are being steadily lowered.

Both the electrified farm and the commercial and industrial sections of the electric light and power companies' exhibit will enable visitors to the Fair to appreciate the multitude of ways in which electricity lends itself to their comfort, convenience and happiness. They will interpret new standards of electrical living on a scale never before possible, and in a manner which will bring nation-wide attention and interest. Millions of people who have as yet no comprehension of the advances which electricity has made to the well-being of the entire nation will thus have the way to better living brought dramatically before them.